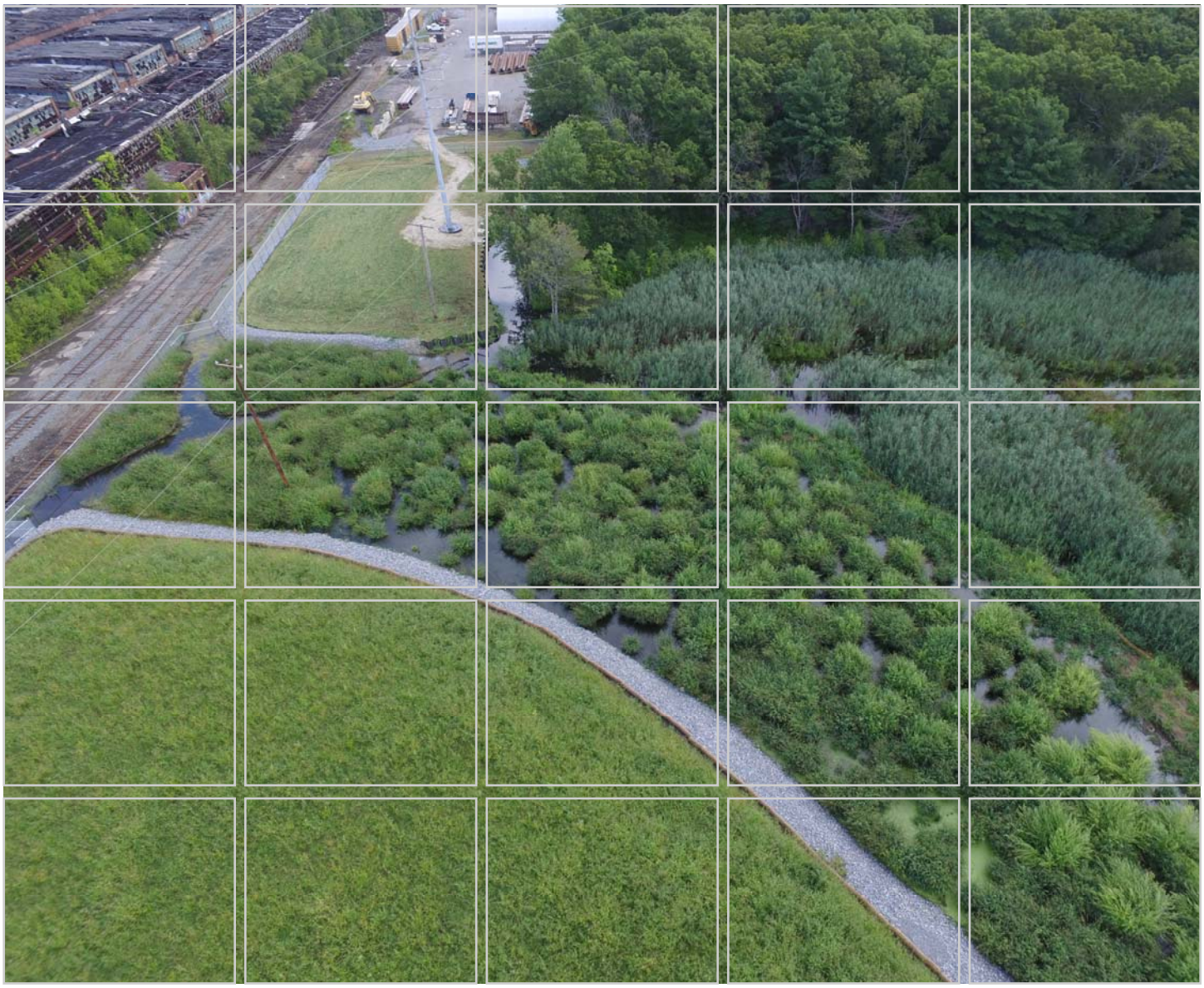

Final Remedial Construction Report AOC 3

Iron Horse Park Superfund Site
Operable Unit 3, Billerica, MA

PanAm Railways

19 November 2020

Delivering sustainable solutions in a more competitive world

FINAL

Final Remedial Construction Report
AOC 3

Iron Horse Park Superfund Site
Operable Unit 3
Billerica, Massachusetts

Pan Am Railways

19 November 2020

Environmental Resources Management
One Beacon Street, 5th Floor
Boston, MA 02108
(617) 646-7800
www.erm.com

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1.0 INTRODUCTION

On behalf of Pan Am Railways (Pan Am, formerly Boston & Maine Railroad), ERM Consulting and Engineering, Inc. (ERM) has prepared this Completion Report for the Iron Horse Park Superfund Site (the "Site"), Operable Unit 3 (OU3), Area of Concern (AOC) 3 in Billerica, Massachusetts. Activities were conducted in accordance with the United States Environmental Protection Agency (USEPA) Record of Decision (ROD) for OU3 dated 30 September 2004 and followed the requirements detailed in the Remedial Design (RD)/Remedial Action (RA) Statement of Work (SOW) for OU3. ERM was retained by Pan Am Railways to be the Engineer of Record for the RD/RA.

This Final Remedial Construction Report and the accompanying set of As-Built Drawings (Appendix A) summarize and document the activities performed leading to the completion of the ROD field activities at the Site. All activities were completed in accordance with the following reports associated with AOC 3 unless otherwise noted:

- *Final Design Report for AOCs 1, 2, and 3* dated 24 September 2012; and
- *Remedial Action Work Plan for AOC 3* dated 25 July 2018.

This report presents the RA activities associated with AOC 3 as completed between 10 September 2018 and 6 August 2019. This report and accompanying drawings discusses the remedial activities, "As-Built conditions," site quality assurance / quality control (QA/QC), design modifications, and achievement of Applicable or Relevant and Appropriate Requirements (ARARs).

The following major sections are included in this Completion Report:

- 1.0 Introduction;
- 2.0 Remedial Action Requirements;
- 3.0 Construction Implementation;
- 4.0 Construction Modifications;
- 5.0 Construction Quality Assurance/Quality Control;
- 6.0 Institutional Controls;
- 7.0 Regulatory Compliance Assessment; and
- 8.0 Future Requirements.

Each section discusses specific Site issues leading to the completion of the RA. Data collected throughout the RA process is appended for reference as supporting documentation.

1.1 BACKGROUND

The Site is located in Billerica, Massachusetts, near the Tewksbury town line, approximately 20 miles northwest of Boston (Figure 1). The Site is a 445-acre industrial complex, which includes manufacturing and railyard maintenance facilities, open storage areas, landfills, and former wastewater lagoons. The Site is used for industrial purposes, with no residential use. The majority of the Site has been disturbed by man-made activities associated with industrial use for almost 100 years. Structures, access roads, storage areas, and landfills cover the majority of the Site.

Ground elevation is generally flat with gradual slopes associated with each of the landfill or disposal areas. The Site is surrounded by upland areas on the southeast side, including several small forested hills near Pond Street, and low-lying wetland areas on the western, northern, and eastern side of the Site. Approximately 17 percent of the Site is covered by wetlands.

The area surrounding the Site is a mix of residential, industrial, and undeveloped land. It is bounded to the north by the B&M railroad tracks, to the west by High Street, to the east by Gray Street, and to the south by a wetland, Pond Street, and the Middlesex Canal.

The B&M Locomotive Shop Disposal Areas (AOCs 3A and 3B) are divided by a man-made channel that flows into perennial Stream A. AOCs 3A and 3B are located north and south of the channel, respectively. AOCs 3A and 3B are 0.4 and 3.6 acres, respectively. Organic compounds, including PAHs, petroleum hydrocarbons, pesticides, and metals were detected in surface and subsurface soils of the AOC 3 units. The highest concentrations of PAHs were generally detected in subsurface soils.

The risk assessment conducted for AOC 3 as presented in the Remedial Investigation (RI) Report dated September 1997 concluded that:

- Soils pose a potential risk to human health based on measured lead concentrations; and
- Soils pose a potential risk to environmental receptors based on measured copper and lead concentrations.

Based on this information, AOC 3 required the implementation of remedial action measures that will (ROD 2004):

- Protect human receptors from exposure to lead in soil;
- Protect environmental receptors from exposure to copper and lead in soil; and
- Limit the migration of contaminants in soil to groundwater.

1.2 PROJECT ORGANIZATION

The RA implementation was conducted by management, inspection, and construction personnel organized to effectively administer, supervise, inspect, and construct the prescribed RA in a sound engineering manner and in compliance with the approved RD, ROD and Consent Decree. Pan Am retained ERM as the engineer of record for the RD/RA SOW, to oversee the construction subcontractor, as needed, and be the Construction Quality Control Officer to ensure compliance with the prescribed requirements. The responsibilities assigned to individual project participants are discussed in this section.

1.2.1 Construction Subcontractor

ERM retained Charter Contracting Company, LLC. (Charter) as the subcontractor for the implementation of the RA. Charter was responsible for furnishing the labor, methods, services, materials, equipment, and installation of all materials related to the RA prescribed in the ROD. Charter was also responsible for implementing construction quality control (CQC) activities for the project. Charter was represented by of the following personnel:

- Charter Project Manager: Chris Ryan
- Charter Field Superintendent: Jeff Hebb
- General Contractor: Charter Contracting Company, LLC

Additionally, Charter retained the following specialty subcontractors during the project:

- Land Surveyor: Dana F Perkins, Inc.
- Brush Clearing: Northern Tree Service, Inc.

- Erosion Control Installation: S&M Farms, Inc.
- Sheet Pile Supplier: Skyline Steel, Inc.
- Sheet Pile Installation: Sea and Shore Contracting, Inc.
- Water Treatment System Installation: Lockwood Remediation Technologies, LLC
- Third Party Wetland Specialist: SWCA Environmental Consultants
- Geosynthetic Manufacturer: Solmax-GSE
- Geosynthetic Installation: Chenango Contracting, Inc.
- Materials Testing: GeoTesting Express, Inc.
- Structural Fill/Cover Soil Supplier: Newport Aggregates
- Wetland Organic Fill Supplier: BMC Corp.
  Aggresource, Inc.
- Topsoil Supplier: Newport Aggregates
  BMC Corp.
- Wetland Hydroseeding: Hydrograss Technologies
- Straw and Tackifier Application, Cap Hydroseeding: A.J. Cameron Sod Farms, Inc.
- Fence Supplier: Reliable Fence Boston

The following subcontractors were also retained by ERM to conduct additional activities at AOC 3:

- Utility Clearance: Ground Penetrating Radar Services, Inc.

1.2.2 Construction Management

ERM provided daily on-Site oversight to ensure design compliance and overall conformance with the RA and Contract Documents, which includes construction drawings and technical specifications. ERM's project personnel interacted regularly concerning site coordination and construction matters and a weekly progress meeting was conducted to summarize completed and upcoming activities at the Site. The construction management team was comprised of the following personnel:

- Engineer of Record & Project Manager: Stacey B. Harvey, P.E., ERM
- Partner in Charger: Lyndsey Colburn, P.G., ERM
- Senior Engineer: Darren Quillen, P.E., ERM
- Construction Manager: Mark Jurgensen, ERM
- CQA Manager: Michael Pettit, E.I.T., ERM
- Field Safety Officer & CQA Inspector: Alec Randall, E.I.T., ERM

1.2.3 Regulatory Agency Inspections

The USEPA and Massachusetts Department of Environmental Protection (MassDEP) were responsible for oversight of remedial activities. The USEPA and MassDEP had the authority to inspect the construction site, review the design and any field revisions, verify that the CQA/CQC practices were being appropriately implemented, and verify that the construction was in compliance with the approved RA.

Don McElroy, USEPA, and Janet Waldron, MassDEP, conducted inspections as part of their periodic attendance at weekly progress meetings held on-site every Wednesday for the duration of the project. Additionally, a representative of AECOM (under contract to USEPA) conducted routine Site inspections approximately 2 to 5 times per week. A Pre-Certification Construction inspection was conducted on 6 August 2019. No follow up items were identified during this inspection besides regular operation and maintenance activities (e.g., wetland inspections, mowing, etc.).

2.0 REMEDIAL ACTION REQUIREMENTS

The RA implementation at the Site was conducted under the jurisdiction of the USEPA, and in accordance with the approved Revised Final Design for AOC 3 (Final Design), dated 24 September 2012.The Final Design was developed in response to the requirements in the RD/RA SOW.

2.1 AOC 3 REQUIREMENTS

In accordance with the 2004 ROD, remedial action measures for AOC 3 were required to limit the migration of contaminants in soil to groundwater. To ensure the RA accomplished the aforementioned goal, the RA measures included within the Final Design for AOC 3 consisted of the following:

- *Capping landfill material* – Grade slopes, install a single-barrier (Solid Waste cap), and install stormwater drainage structures (swales, rip-rap, perimeter drains), detention basins, and gas vents, as necessary;

- *Erecting a fence around the landfill* – Install fence to prevent unauthorized access in order to safeguard the public, and prevent damage to landfill structures;

- *Instituting land use restrictions* – Restrict activities (such as excavation and construction) which may damage the landfill cap and cause exposure to and migration of landfill contaminants;

- *Restoring wetlands impacted by the cleanup*- Install wetland soils and replant with appropriate species as necessary;

- *Inspecting and maintaining the landfill cap and fence on a periodic basis to ensure that it remains effective, inspecting and monitoring institutional controls and inspecting and maintaining wetland areas* – Define a maintenance program to inspect landfill structures, fence, and institutional controls and restored wetland areas and maintain/repair as necessary; and

- *Sampling groundwater periodically to assess the effects of the source control action (capping) and any ongoing impacts from the landfill, installing, if necessary, new monitoring wells*– Monitor groundwater quality downgradient of landfill.

The remedial action requirements were met and are documented in the activity descriptions and appendices presented herein (with the exception of instituting land use restrictions).

3.0 CONSTRUCTION IMPLEMENTATION

Charter was retained by ERM to provide all labor, equipment, and requisite materials to complete the construction and implementation of the RA. Their selection was the result of a competitive bidding process. Charter hired additional specialty subcontractors to perform minor supplemental tasks. During implementation, ERM provided construction and field-engineering oversight of the project.

3.1 CONSTRUCTION OVERVIEW

Charter mobilized to the Site on 10 September 2018 and began construction activities in accordance with the Contract Documents and the approved Final RD. The RA was substantially completed on 21 June 2019. ERM oversaw all portions of the construction activities and was on-Site during all construction activities. The Pre-Certification Construction Inspection was performed by representatives from ERM, USEPA, MassDEP, and AECOM on 6 August 2019 for AOC 3.

The work for AOC 3 consisted of the following:

- Installation of erosion and sediment controls.
- Removal of surface features including:
    - Trees/brush/stumps;
    - Concrete blocks;
    - Miscellaneous debris (spools, tires, railroad ties, etc.); and
    - Abandonment of four existing groundwater piezometers.
- Excavation of waste outside of the limits of cap and consolidation within the limits of cap.
- Landfill capping
    - Shaping, grading, and preparation of existing subgrade.

    - Placement of cover materials including:
        - 60-mil textured low density polyethylene (LLDPE) geomembrane;
        - Geocomposite for lateral drainage – a high density polyethylene (HDPE) geonet with non-woven geotextile thermally bonded to both sides;
        - 5,400 CY of cover soil; and
        - 2,900 CY of topsoil.
    - Construction of access roads to the top of each landfill lobe.
- Wetland creation and restoration
    - Creating 31,318 square feet of new wetland;
    - Restoration of 10,246 square feet of existing wetland; and
    - 1,414 CY of organic fill.
- Final site restoration including seeding application and wetland planting, installation of site perimeter fencing, removal of erosion and sediment controls upon establishment of permanent vegetation.

With the exception of those activities presented in Section 4.0 – Construction Modifications, these construction events were conducted in accordance with the construction drawings, technical specifications, and the final RD.

3.2 CONSTRUCTION SEQUENCE

RA implementation was planned and conducted in a logical series of activities to facilitate the execution through substantial completion. The total duration of this project was ten months.

In mid-September 2018, Charter began clearing vegetative material from the landfill and installed erosion and sediment controls including sediment fence, Supersilt fence, a stabilized construction entrance, two rock check dams, and a barrier of sand super sacks within the wetland to mitigate erosion and sediment laden runoff. The existing soil on AOC 3 was shaped and graded to

determine the amount of borrow material required to meet minimum slope specifications.

The subgrade was prepared to produce a uniform surface free of debris and objects that may damage the overlying geomembrane.

Sheet pile walls were installed on the perimeter of AOC 3 in locations where it was not possible to connect the side slopes directly into the surroundings elevations with an acceptable slope. The total sheet pile length is approximately 325 linear feet. Sheet pile was installed on the south-southeastern sides of AOC 3A, where the adjacent stream and the National Grid pole made it impossible to have a continuous acceptable slope. On AOC 3B, sheet pile was installed directly adjacent to the rail road tracks on the northern side of 3B to prevent grading and excavating near the National Grid pole. All sheets were driven with a vibratory pile hammer and torch cut to the desired elevation. Sheet pile installation was conducted by Sea and Shore, Inc.

In the wetland restoration area, the existing grade was excavated to an elevation of 111 feet above mean sea level (ASML). After waste was removed from this area, clean structural fill was imported and backfilled to a thickness of one foot and three inches. In spring 2019, one foot layer of imported organic material was added to construct the final wetland elevation to 113.25 feet AMSL. Hummocks, between one to two feet in height, were distributed non-uniformly throughout the restoration area. At this elevation the groundwater table is able to fluctuate along the sides of these hummocks, resulting in a restored wetland that is partially submerged at all times.

Wetland restoration was conducted using a phased excavation approach to minimize the generation of contact water. In this approach, waste material was excavated from the wetland in discreet cells. Each cell was immediately backfilled with clean, imported structural fill following excavation. This approach did not leave open excavations for water to reenter, limiting the need for additional dewatering and treatment of contact water.

Geosynthetic installation began at the beginning of April 2019. Geomembrane was installed after the subgrade acceptance inspection was complete. The rolls were transported using a skid steer with spreader bars from the stockpile area to the area of work. The panels were temporarily anchored with sandbags until they were seamed together with a dual hot-wedge fusion welding apparatus. The geomembrane was overlain by a geocomposite drainage layer to promote the drainage of infiltrated water in the cover soil.

In April and May 2019, cover soil was placed over the geosynthetic layers. Routine surveying was used to assess whether the grade conformed to the

final RD. The placed and compacted cover soil was tested for in-place soil density at a frequency of no less than five tests per acre. The density testing confirmed that placed soils met the design requirements for compaction.

The cover soil was then overlain by a six-inch layer of topsoil and hydroseeded. In early May 2019, a wetland seed mix was then applied to the wetland restoration area. In order to establish vegetation and achieve site stabilization as quickly as possible, a seed mixture consisting of two parts *New England Wetmix* to one part *New England Erosion Control/Restoration Mix for Detention Basins and Moist Sites* was utilized. This seed mix was provided by New England Wetland Plants, Inc.

When possible, multiple phases of work were conducted simultaneously to promote an efficient project schedule. The chronology of work activities is summarized below:

10 to 18 Sept 18	Mobilization, surveying, tree clearance
18 Aug to 12 Oct 18	Debris removal, stump removal and stockpiling, installation of sedimentation and erosion controls
15 Oct to 28 Nov 2018	Shaping and preparation of subgrade
23 Oct to 02 Nov 2018	Installation of the sheet pile wall on AOC 3A and 3B
23 Oct to 30 Nov 2018	Excavation and backfill of wetland creation and restoration area
30 Nov to 14 Dec 2018	Winterization, installation of additional erosion controls
01 to 09 April 2019	Remobilization and site repair following winter shutdown.
10 to 25 April 2019	Installation of geomembrane
17 April to 25 May 2019	Installation of geocomposite drainage layer
23 April to 16 May 2019	Installation of cover soil on AOC 3A and 3B
25 April- 17 May 2019	Installation of top soil AOC 3A and 3B
30 April to 9 May 2019	Installation of organic soil in wetland

10 to 20 May 2019	Seeding of landfill caps and wetland
10 to 11 June 2019	Planting of wetlands plants
21 to 31 May 2019	Security fence installation
17 to 19 June 2019	Super sand bag removal
26 June 2019	Final erosion control removal
6 August 2019	Pre-Certification Construction Inspection

A photographical log of the RA is provided as Appendix B.

3.3 Pre-Certification Construction Inspection

The Pre-Certification Construction Inspection was conducted on 6 August 2019 for AOC 3 to confirm all items identified during prior site visits had been addressed. Attendees at the final, post-construction inspection are listed below:

- Don McElroy – USEPA
- Janet Waldron - MassDEP
- Lyndsey Colburn – ERM
- Stacey Harvey – ERM
- Sean Czarniecki - AECOM
- Rick Purdy – AECOM

4.0 CONSTRUCTION MODIFICATIONS

Constructions modifications were implemented during the RA as a consequence of varying field conditions and operations to improve the implementation and function of the overall remedy. The modifications are consistent with the intent of the approved ROD and the intent of the Final Design. All construction modifications were presented to EPA/DEP for comment and revised, if necessary. Those construction modifications are presented below and documented in the As-Built Drawing (Appendix A).

4.1 EROSION AND SEDIMENT CONTROLS

The wetland area bordering AOC 3 to the east was subject to high water levels which prevented the installation of a Super Silt Fence. Instead, a dam made of Super Sand Sacks was constructed to serve as a sediment and erosion control barrier in this area. The dam consisted of one cubic yard super sacks filled with sand, installed along the Limit of Disturbance (LOD) to match the intended Super Silt Fence line. This dam served to contain sediment from the site within the LOD and facilitate dewatering activities for excavation.

4.2 SHEET PILE ADJUSTMENTS

In the Northeast corner of AOC 3A, a subsurface obstruction was encountered during the installation of sheet pile. Further investigation revealed that the obstruction, believed to be a large boulder or stone shelf, was impractical to puncture through or remove from the subsurface. As a result, the northernmost 18 feet of sheet pile wall from stations 2+22 to 2+40 could not be installed to the target embedment depth of 15 ft below ground surface (bgs). The embedment depth in this area was 6.34 ft. bgs, which is 8.66 feet less than the required embedment depth. ERM determined that this section of sheet pile could support backfill to an elevation of only 113.5 ft. ASML while maintaining an acceptable factor of safety. In this area, a stone toe drainage basin was installed as an alternative to the sheet pile wall cap termination.

To accommodate this, cap limits were nominally adjusted such that the limits of cap are approximately 10 ft back from the sheet pile wall from stations 2+22 to 2+40. This adjustment was approved as test pits within this area indicated that no waste material exists outside of the adjusted cap limit. The modification to the sheet pile installation was approved by the USEPA on 7 February 2019. See Appendix C for further construction details.

4.3 SWALE EROSION CONTROLS

The Final Design called for the two drainage swales bordering the northwestern side of AOC 3A and B to be stabilized with vegetation. During construction, erosion within the swales was evident and difficult to control during the wet season. ERM determined that more robust control measures would be required to adequately stabilize the drainage swale throughout construction. Therefore, AOC 3B's swale was lined with riprap armoring along the floor and sidewalls. AOC 3A's swale was lined with riprap along the floor and erosion control mats lined the side slopes due to insignificant area for stone to be installed. The armoring of both swales will mitigate long term erosion controls.

4.4 WINTERIZATION PLAN

Additional winterization measures were taken to protect the site between December 2018 and April 2019. Straw mulch and tackifier were added to all areas at or above the 115' contour across AOC 3A and 3B. Erosion control matting was added to the transitions from the sheet pile walls to earthen slopes to limit erosion. Additional 12" coir logs were installed as part of this winterization effort; two along the wetland transition shelf on 3B, and one along the northern and western toe of slopes of 3A.

Geosynthetics were delivered to the site between 12 and 14 December 2018 and were stored on-Site through the winter. All geosynthetics were stored on plank dunnage, covered with ultraviolet-light-resistant poly sheeting, and weighed down with sandbags for storage. Inspections of the site and stored geosynthetics were conducted regularly by ERM and AECOM throughout the winter. Any erosion areas or other damage identified in inspections were promptly repaired by Charter. All repairs were reviewed by ERM and AECOM to ensure that the site maintained stable condition throughout the winter.

4.5 AOC 3B SOUTH SLOPE

Along the southeast edge of AOC 3 B, adjacent to the wetland restoration area, an elevated shelf of structural fill was created to provide space for a typical cap drainage transition. Due to the steep incline of the slope leading down from the transition shelf to the wetland, additional measures were taken to mitigate the risk of long term erosion. The outer slope was covered with geotextile and armored with six to ten-inch sized rip rap to control sheet flow

from the top of cap and mitigate the erosion of structural fill into the wetland restoration area.

4.6 SUPER SAND BAG REMOVAL & WETLANDS UPDATE

Following completion of all other construction activities and establishment of wetland vegetation, the super sack dam described in Section 4.1 was reincorporated into the wetland restoration area as a row of elevated hummocks. Using a mini excavator, the sandbags were lifted and cut in-place. The plastic wrapping of the super sacks were removed and disposed of off-Site, and the sand within the bags was temporarily left in place as an elevated windrow bordering the wetland restoration area. Immediately following, a mini- excavator was used to reshape the sand windrow into a series of six elevated hummocks. These hummocks were then covered with organic wetland soil, seeded, and blanketed with biodegradable erosion mats secured with wooden stakes. The hummocks were then vegetated with woody wetland species consistent with the wetland mitigation plan. The final hummocks were designed to be 50 feet long with ten foot gaps in between to allow for hydraulic continuity between the existing and restored wetland. The exact dimensions of the hummocks were adjusted in the field to be non-uniform, mimicking natural land features.

To incorporate the addition of forested wetland hummocks to the restoration design, some updates were made to the layout of the wetland zones provided in the Final Design. These updates included switching the easternmost edge from a classification of palustrine emergent (PEM) to palustrine forested (PFO). The seeds, plants, and total square footage allocated to PEM and PFO remained the same, but their physical locations were adjusted. The PEM zone was relocated to the westernmost edge of the created wetland area, along the toe-of-slope of AOC 3B. The PFO zone was shifted to the eastern edge of the wetland restoration area, including the line of hummocks constructed from the reincorporated super sack dam. This change created a denser buffer along the outer boundary of newly created wetlands, assisting to mitigate the spread of *phragmites* from the existing wetland into the wetland restoration area. The original palustrine scrub-shrub (PSS) area was not changed from the original design. The PEM designated area located in the northern portion adjacent to AOC 3A also remained unchanged from the original design. The classification areas are shown on Drawing 05 in Appendix A. A list of the wetland plant species and quantities is provided in Table 1. The modification to the wetland design was approved by the USEPA on 11 June 2019. See Appendix D for further construction details.

5.0 CONSTRUCTION QUALITY ASSURANCE / QUALITY CONTROL

Quality assurance and quality control (QA/QC) measures were implemented per the Construction Quality Assurance/Quality Control Plan approved for AOC 3. For this Site, QA/QC activities included inspections to confirm proper installation of the geosynthetic materials, piezometer decommissioning, density testing, and material thickness measurements. A description of responsibilities, procedures and results throughout construction are presented below.

5.1 POSITION RESPONSIBILITIES

Charter was responsible for the quality of construction and for compliance with the construction documents, drawings and specifications and, fulfilling applicable regulatory requirements. ERM had ultimate responsibility for the assurance of conformance with the construction drawings, specifications, and the intent of the Final Design. QA and QC personnel responsibilities and assignments throughout implementation are discussed below.

5.1.1 Construction Quality Assurance

On behalf of Pan Am, the Engineer of Record had the ultimate responsibility for the assurance of conformance with the construction drawings, specifications and SOW requirements.

5.1.2 Construction Quality Control

Charter was responsible for conducting the work in accordance with the Final Design, the applicable contract specifications and, to do so, employing best industry practices. Construction was conducted in a safe and controlled manner. Charter was responsible for providing an experienced Site Superintendent capable of ensuring that all applicable quality and contract performance responsibilities were satisfied. All QA activities for the project were coordinated between ERM and the Contractor's QC/Site Superintendent and together, they had direct control of the construction team, subcontractors, and project scheduling.

5.1.2.1 Construction Teams

Charter employed experienced, safety-trained construction labor. These contractors and subcontractors were trained for the functions they performed and the equipment they operated.

5.2 QUALITY ASSURANCE AND QUALITY CONTROL ACTIVITIES

QA/QC activities included the following:

- Engineer of Record or representative thereof review of material specifications against the Final Design prior to placement.
- Visual inspections were conducted by the Project Manager, Construction Manager, and/or CQA Manager upon delivery of geosynthetics and granular materials and prior to placement to verify material integrity and consistency with submitted material specifications.
- Visual inspections were conducted by the Engineer of Record or representative thereof to verify proper installation of the geosynthetics, material thicknesses, and geomembrane seaming.

QA/QC procedures associated with each geosynthetic component were conducted in accordance with the technical specification and are outlined in Sections 5.3 through 5.5 below.

5.2.1 Conformance Testing

As required by the Design Specifications, QC certification of geotextile was provided by the manufacturer. The certifications and testing covered the following:

- Material Identification
- Roll Number
- Manufacture Date
- Testing Results
    - Weight
    - Grab Tensile Strength
    - Trapezoid Tear Strength

- CBR Puncture Strength
- Apparent Opening Size (Type 1)
- Permittivity (Type 1)
- UV Resistance (Type 2)
- Puncture (Pin) Strength (Type 2)

The results of the QA/QC testing satisfactorily met the requirements in the design specifications. The material certifications and testing results are summarized in Appendix E.

5.2.2 Delivery and Storage

The geotextile was ordered and delivered in stages corresponding with the construction schedule.

Geomembrane and geocomposite were stored onsite through the winter in accordance with manufacturer specifications. Rolls were stacked atop plank dunnage and wrapped with opaque tarps to prevent UV damage for the duration of onsite storage. Charter and ERM checked delivery invoices and rolls for evidence of damage during shipment. Over the winter, geosynthetics were regularly inspected for damage or improper storage by ERM and AECOM as part of the site's overall winterization plan. Any damaged material was removed or repaired prior to or during installation, as appropriate. No damage was reported or observed.

5.2.3 Deployment

The RA Contractor's geosynthetics installer subcontractor, the RA Contractor, and ERM monitored deployment and seaming activities. This included verifying proper overlap, proper handling, and proper placement procedures

5.3 GEOMEMBRANE LINER

Installation requirements for the 60-mil LLDPE geomembrane were presented in Final RD, including in Specification Section 02713- Geomembrane. The physical property requirements of the 60-mil texture LLDPE were also presented in Specification 02713.

5.3.1 Pre-Installation Material Certification and Testing

QC certification and manufacturer's Quality Control testing of all rolls were provided. The following was the information provided on the QC certification and testing:

- Material Identification
- Roll Number
- Batch Number
- Resin Shipment Container Identification
- Manufacture Date
- Testing Results
    - Average Thickness
    - Carbon Black
    - Melt Index
    - Density
    - Tensile Properties
    - Puncture resistance
    - Tear Resistance

The test results satisfactorily met or exceeded the design specifications. Geomembrane conformance test results are presented in Appendix F.

5.3.2 Delivery and Storage

The LLDPE geomembrane rolls were stored in accordance with manufacturer recommendations. The RA Contractor checked delivery invoices and condition of material upon arrival. Damaged geomembrane rolls were marked and portions of the damaged rolls were removed prior to installation or repaired after installation, if necessary.

5.3.3 Geomembrane Deployment

Geomembrane was installed immediately after subgrade acceptance inspection and only on subgrade that met the criteria of Section 02713 as verified by joint inspection by the RA Contractor and ERM CQA personnel. The EPA oversight contractor representative also observed that subgrade conditions appeared to be generally acceptable during visits to the site. Subgrade acceptance forms are provided in Appendix F.

A skid steer equipped with spreader bars was used to transport the rolls from the stockpile area to the area of work and unroll them for final placement. Smaller panel placements and adjustments were achieved by hand-pulling using hand clamps fastened to the geomembrane. The geomembrane panels were assigned an identification number, which was based upon the sequential order in which the panels were deployed. The panel layout is illustrated on the record drawings in Appendix F.

The geomembrane panels were temporarily anchored with sandbags until they were seamed together. Damaged or blemished areas of the geomembrane were repaired in accordance with specifications. The RA Contractor, their geosynthetics installation subcontractor, and ERM visually monitored the geomembrane panels during deployment for alignment, sheet surface quality, overlap with adjacent panels, identification (roll number and panel number), panel length, and underlying surface quality. QA and QC records were kept during deployment and are presented in Appendix F.

5.4. SEAMING

5.4.1 Trial Seams

Trial seams were made for each fusion/extrusion welding machines and operator at the start of each day and after each work break/stoppage that resulted in an equipment shutdown. Trial seams were made with pieces of geomembrane welded together under the same ambient air conditions as the field seaming to be performed. Trial seam testing established temperature and speed settings on the welding units conducive to formation of acceptable seams. Six sample coupons were cut from each trial seam. Three of the six coupons were tested in the peel mode of the inner and outer weld and three coupons were tested in the shear mode with a calibrated tensiometer. This tensiometer was used to verify Film Tear Bond as well as shear and peel strength requirements of 100 and 70 pounds per inch for fusion welding, and 100 and 50 pounds per inch for extrusion welding, respectively. Trial seam testing documentation is provided in Appendix F.

5.4.2 Field Seams

The majority of geomembrane field seams were made using a dual hot-wedge fusion welding apparatus. Repairs and short seam segments were made using an extrusion welding apparatus. The seaming operations were observed and documented by the RA Contractor's geosynthetics installation subcontractor, the RA Contractor, and ERM. The entire length of all seams, patches, or other repairs were also measured, observed, and documented.

Monitoring of the seaming process for quality assurance purposes consisted of periodic observations to ensure that the proper procedures were being followed, including seam preparation, seaming apparatus temperatures, and completed seam quality. Seaming imperfections were marked and subsequently repaired in substantial conformance with Design Specification Section 02713-J Defects and Repairs.

A tracking process was used during the field seaming. Each seam was identified with a unique seam number, which consisted of the panel numbers joined by the seam. Other recorded seam data included the date and time, length, name of welder, and welding device number. This information is presented in Appendix F.

5.4.3 Nondestructive Testing

All nondestructive seam continuity testing was performed by the RA Contractor's geosynthetics installer subcontractor and observed by the RA Contractor and ERM. Two types of nondestructive testing were performed:

- Air pressure testing
- Vacuum box testing

The fusion seams were nondestructively tested by air pressure testing the channel formed between the two tracks formed during seaming by the dual hot-wedge fusion welding apparatus. The end of the seam to be pressure tested was sealed and a hollow needle with an attached pressure gauge was inserted in one end of the seam. The seam channel was filled with air using an electric air compressor to reach a pressure between 25 and 30 psi. The pressurized channel was monitored for a period of five minutes. For the seam to meet specifications, the seam was permitted to lose no more than 4 psi during a 5-minute period. Following the 5-minute period, the seam end opposite to the needle was cut, and the pressure drop was observed. This method was performed to verify that the entire seam length was tested and that the air channel was not blocked by debris or sealed by overheating during seaming. If a section of seam did not pass the air test, then the leak or blockage was located and repaired. The seam was then retested on both sides of the defection or the seam would be repaired by leistering and extrusion welding a patch of geomembrane across the failed seam length and subsequently nondestructively (vacuum) tested. A summary of the QA/QC test results for the seams of geomembrane air pressure testing is presented in Appendix F. Extrusion welded seams and repairs were nondestructively tested using a vacuum box assembly. The vacuum box assembly consisted of a rigid housing, a transparent viewing window, a soft rubber gasket attached to the base, a valve assembly, and a vacuum gauge. The rubber gasket component

allows the vacuum box to form an airtight seal with the geomembrane. Vacuum box testing was conducted by applying a soapy water solution to the seam and placing the vacuum box over the seam. A vacuum pump assembly equipped with a pressure controller was used to draw a vacuum of 5 psi on the chamber for approximately 30 seconds, and the weld area was observed. Any area where soap bubbles appeared generally indicated a seam discontinuity or leak. These areas were marked, repaired, and retested in accordance with the technical specification. QA/QC nondestructive test results for extrusion welds are included in Appendix F.

5.5 DESTRUCTIVE TESTING

5.5.1 Sampling and Test Procedures

Geomembrane destructive seam test samples were obtained on an average of one for every 500 linear feet of seam of each welding apparatus, which was in accordance with the technical specifications. The test locations were selected by ERM based either on completion of approximately 500 feet of welding or on individual weld observations (e.g., biased to areas of variable welding). After marking the sample location, the RA Contractor's geosynthetics installer cut the sample, which was typically 12 inches wide by 44 inches long with the seam centered lengthwise, from the installed geomembrane. The geomembrane destructive sample was cut typically into three sections and distributed as follows:

- One 12-inch by 12-inch section to ERM for laboratory testing;
- One 12-inch by 12-inch section to the RA Contractor for laboratory testing; and
- One 12-inch by 12-inch section for archive storage.

Destructive samples were field tested with a calibrated tensiometer prior to being sent for laboratory testing. Four coupons were cut from each destructive sample. Two coupons were tested for peel strength for the inner and outer seam on fusion welds and two were tested for shear strength. Upon acceptance of the field testing, destructive samples were shipped to the offsite QA and QC laboratories for testing. Ten coupons were sent from each destructive sample. Five coupons were sent to test peel strength for the inner and outer seam on fusion welds and five were tested for shear strength. Acceptance criteria for the destructive samples were 70 pounds per inch for peel and 100 pounds per inch for shear for fusion welding, and 100 and 50 pounds per inch for extrusion welding, respectively. The locations of the

geomembrane destructive tests and a summary of the destructive samples test results can be found in Appendix F.

5.5.2 Tracking of Failed Destructive Samples

There were no failed destructive tests. A summary of the field and laboratory test results can be found in Appendix F.

5.5.3 Repairs

All destructive sample and air pressure testing locations were extrusion welded and nondestructively tested using a vacuum box. The RA Contractor's geosynthetics installer subcontractor, the RA Contractor, and ERM observed repair activities and documented that the identified defects were repaired and nondestructively tested in accordance with the technical specifications. QA/QC nondestructive test results and the locations of the repairs for extrusion welds are included in Appendix F.

5.5.4 Interface Shear Testing

Interface shear testing was performed to verify the stability of the cap system interfaces, particularly on the 3 Horizontal: 1 Vertical slope areas. Shear interface friction angle testing was performed on the following cap components:

- geomembrane- existing subgrade interface;
- geomembrane- subgrade fill interface;
- geotextile-geomembrane interface;
- geomembrane-geocomposite interface;
- geocomposite-cover soil interface; and
- cover soil-cover soil interface.

Testing performed met or exceeded the material property requirements specified in the design. Testing data are provided in Appendix F.

5.6 GEOCOMPOSITE DRAINAGE LAYER

The geocomposite drainage layer was installed to help promote drainage of water that infiltrates through the cover soil. The geocomposite is manufactured from a geonet and lamination of a nonwoven geotextile on the top and bottom of the geonet. The fabric permits water to permeate, yet

prevents the adjacent soil from washing through the core. Installation and physical property requirements for the geocomposite were presented in Design Specification Section 02712 Geocomposite.

5.6.1 Conformance Testing

As required by the Design Specifications, QC certification of geocomposite was provided by the manufacturer. Periodic QA/QC laboratory testing was also performed to verify that the material met the material property requirements in the design. The certifications and testing covered the following:

- Material Identification
- Roll Number
- Batch Number
- Resin Shipment Container Identification
- Manufacture Date
- Testing Results
    - Average Thickness
    - Carbon Black
    - Melt Index
    - Density
    - Tensile Properties
    - Weight
    - Transmissivity
    - Ply Adhesion
    - Apparent Opening Size
    - Permittivity
    - UV Resistance

The results of the QA/QC testing satisfactorily met the requirements in the design specifications. The material certifications and testing results are summarized in Appendix G.

5.6.2 Delivery and Storage

The geocomposite was ordered and delivered in stages corresponding with the construction schedule.

Storage was in accordance with manufacturer specifications. The RA Contractor field personnel checked delivery invoices and rolls for evidence of damage during shipment. Any damaged material was removed or repaired prior to or during installation. No substantial damage was reported or observed.

5.6.3 Deployment

Geocomposite was installed over the completed sections of geomembrane following geomembrane acceptance and testing. The geocomposite rolls were transported to the deployment location and unrolled using a skid steer and spreader bar. Final panel placement was achieved by hand adjusting the panels. Sandbags were utilized to temporarily anchor the material in place until seaming. The RA Contractor's geosynthetics installer subcontractor, the RA Contractor, and ERM monitored the deployment of the geocomposite to ensure proper overlap, to verify proper handling and placement procedures, and to verify protection of the installed geomembrane.

The geonet portion of the geocomposite was seamed by the placement of plastic ties. The ties were of a contrasting color to aid in inspection of the seams. Ties were placed a maximum of five feet apart on adjacent seams and two rows of ties two feet apart on roll ends. The geosynthetics installer subcontractor, the RA Contractor, and ERM monitored the placement and spacing of the ties.

The geotextile portion of the geocomposite was overlapped and sewn the full length of the seam by the contractor using the specified material and procedures in Design Specification Section 02712-3.02. The seaming activities were monitored closely to ensure seam quality and completeness. Any portion of the seam that was not correctly stitched together was marked for repair and corrected. Any portion of the seam or geotextile that was damaged or in need of a patch was repaired utilizing a geotextile patch of the same type that extended a minimum of 12 inches larger in all directions of the area that was to be repaired. A final inspection of all areas was performed by geosynthetics installer subcontractor, the RA Contractor, and ERM personnel prior to acceptance.

Upon completion and acceptance of the geocomposite drainage layer portion of the cap system, the geocomposite was covered with soil in accordance with the specifications outlined in Design Specification Section 02200.

5.7 PIEZOMETER DECOMMISIONING

Groundwater piezometers (PZ-104A, PZ-104B, PZ-105B, and PZ-106B) were decommissioned by Charter on 22 October 2018 in accordance with MassDEP regulations. The piezometers were abandoned in place through filling with bentonite and cutting the PVC at the surface. None of the abandoned wells were part of the long term groundwater monitoring program. Piezometer decommissioning reports are included as Appendix H.

5.8 MATERIAL THICKNESS & GRADES

Grade stakes, field measurements, and routine surveying were used to assess whether the grades and layer thicknesses conformed to the Final RD. The subbase and final condition surveys can be found in Appendix A.

5.9 DENSITY TESTING

Compacted cover soil was tested for in-place soil density at a frequency of no less than five tests per acre (thirty-two total tests). The density testing confirmed that placed soils met the design requirements for compaction (Table 2).

6.0 INSTITUTIONAL CONTROLS

Institutional controls will be applied to AOC 3 in accordance with the Institutional Control Plan, which describes non-engineered administrative and legal measures to reduce the potential for human exposure to contamination and to protect the remedial remedy.

7.0 REGULATORY COMPLIANCE ASSESSMENT

7.1 RECORD OF DECISION COMPLIANCE

As outlined in the RD, the RA was intended to "…mitigate, restore and/or prevent existing and future potential threats to human health and the environment." The ROD specified three remedial action objectives specific to AOC 3:

- Limit the migration of contaminants in soil to groundwater;
- Prevent exposure to lead soil concentrations greater than 1,736 mg/kg; and
- Protect short-tailed shrews and other small mammals from exposure to copper and lead in soils.

The components of the remedy were implemented to meet those objectives and inspections, maintenance, institutional controls and monitoring will ensure long term effectiveness.

7.2 APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS COMPLIANCE

The Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) requires remedial actions at National Priorities List (NPL) sites to meet the ARARs under federal or state environmental laws and regulations. For on-site work, CERCLA actions do not require a permit; however, substantive requirements of the ARARs need to be met.

Section M in Part II and Table L-10 of the ROD presents the federal and state ARARs that may apply to work that would be conducted at AOC 3. The selected remedies presented in the ROD were developed to comply with the substantive requirements of these ARARs. This section summarizes the primary chemical-, location-, and action-specific ARARs that directly apply to the work conducted at AOC 3.

Chemical-Specific ARARs

Chemical-specific ARARs are health- or risk-based concentration limits or ranges that establish acceptable limits or concentrations of a contaminant, or a basis for calculating such limits. There were no applicable or relevant and appropriate chemical-specific ARARs for AOC 3. However, the following guidance was characterized as "to be considered":

- Recommendations of the Technical Review Workgroup for Lead for an Approach to Assessing Risks Associated with Adult Exposures to Lead in Soil- EPA guidance for evaluating the risks posed by lead in soil;

- Cancer Slope Factors - Guidance used to compute the individual incremental cancer risk resulting from exposure to carcinogenic contaminants in Site media; and

- Reference Dose - Guidance used to characterize human health risks due to non-carcinogens in Site media.

Location-Specific ARARs

Location-specific ARARs establish restrictions on the types of remedial activities that can be performed based on specific location, such as wetlands or floodplains. AOC 3 is located within state and local jurisdictional areas. The federal, state, and local laws and regulations that affect work conducted in AOC 3 include the following:

- Wetland ARARs – The remedial action was designed and implemented to minimize impacts to wetlands. In accordance with state and federal regulations, temporary and permanently disturbed wetlands were restored and mitigated as needed.

    - Clean Water Act (33 USC. §1251 et seq.); Section 404(b)(1) Guidelines for Specification of Disposal Sites for Dredged or Fill Material (40 CFR Part 230, 231 and 33 CFR Parts 320-323) – The project was located both within the 100-foot Buffer Zone of a wetland, and within a delineated wetland area. Sedimentation and erosion control measures were installed to minimize impacts to the surrounding wetland, prevent discharges of fill material, and protect aquatic ecosystems. Perimeter control measures included rock check dams, coir logs, silt fencing, super silt fencing, and turbidity curtains installed within Stream A. All pump discharge points were contained within textile filter

bags and treated with flocculation logs to induce settlement of suspended solids prior to discharge.

- Wetlands Protection Act (Mass. Gen. Laws ch. 131, §40), Wetlands Protection Regulations (310 CMR §10.00) – The project was located within both within the 100-foot Buffer Zone of a wetland, and within a delineated wetland area. Measures were taken to minimize adverse impacts to nearby wetland resource areas during construction and the contact water treatment system was designed to meet the MassDEP Standards, as applicable.

- Executive Order 11990 "Protection of Wetlands" (40 CFR Part 6, Appendix A) - Though the remediation activity took place within a wetland, no further construction is proposed within wetlands and the remedy was intended to restore wetland and improve conditions proximate to existing wetlands. To minimize impacts to the surrounding wetland, the construction footprint was reduced to the minimum area required to achieve remediation goals. Sedimentation and erosion control measures were implemented as described above, and all temporarily disturbed wetland was restored in place following construction. Additional wetland area was also created at AOC 3 to mitigate wetlands disturbed by remedial actions at the other onsite AOCs.

- Fish & Wildlife ARARs – The activities associated with AOC 3 did not involve impacts to any federally listed threatened or endangered species based on the U.S. Fish and Wildlife Service list of species for Middlesex County. Therefore, consultation with the U.S. Fish and Wildlife Service was not required.

    - Fish and Wildlife Coordination Act (16 USC 16 USC §661 et seq.), Fish and Wildlife Protection (40 CFR §6.302(g)

Action-Specific ARARs

Action-specific ARARs establish controls or restrictions on the design, implementation or performance of a remedy. The following federal and state laws and regulations affect the actions to be conducted at AOC 3.

- Surface water pollution ARARs – Remedial activities were conducted to minimize impacts of site-related contaminants to surface water.

- Clean Water Act Ambient Water Quality Criteria (40 CFR 120); and

- Massachusetts Clean Waters Act (Mass. Gen. Laws ch. 21 §§26-53); Water Quality Certification for Discharge of Dredged or Fill Material, Dredging, and Dredged Materials in Water of the United States within the Commonwealth (314 CMR §9.00).

- Hazardous Waste Management ARARs – hazardous waste generated during the course of remedial activities was handled and managed in accordance with the requirements of the federal and state hazardous waste regulations.

    - RCRA Subtitle C – Hazardous Waste Identification and Listing Regulations; Generator and Handler Requirements (40 CFR Parts 260-262 and 264); and

    - Management Standards for all Hazardous Waste Facilities (310 CMR 30.500), Waste Analysis (310 CMR 30.513); Management Standards (310 CMR 510).

- Solid Waste Capping ARARs – The remedial actions comply with the closure/post-closure standards through capping, monitoring and institutional controls. The cap construction addressed potential risks to human health and the environment and prevents migration of contaminants to surface water and groundwater.

    - Massachusetts Solid Waste Management Regulations (310 CMR 19.00); and

- Massachusetts Department of the Environment (MassDEP) Landfill Technical Guidance Manual; Massachusetts Solid Waste Management Regulations (310 CMR 19.00) – Wastes generated during the course of the remedial activities that were determined to be non-hazardous were handled and managed in accordance with the requirements of state solid waste regulations.

- Air Pollution ARARs - Actions were taken to control the generation of dust during excavation and capping activities, as needed.

    - Massachusetts Air Pollution Control Regulations (310 CMR 7.09).

8.0 FUTURE REQUIREMENTS

O&M procedures are described in detail in *Appendix H: Operations and Maintenance Plan AOCs 1, 2, 3, and 6* of the *Final (100%) Remedial Design for AOCs 1, 2 and 3* dated September 24, 2012. The O&M plan for AOC 3 addresses the following:

- Post-closure inspection of cap construction areas, storm water controls, fencing, monitoring wells, sheet pile, drainage features, and perimeter security fence;
- Mowing on an as-needed basis and removal of any identified woody plants on and in the immediate vicinity of the cap;
- Documentation and reporting; and
- Routine maintenance and repairs.

On-going inspections have been, and will continue to be, performed including the cover system, fencing, sheet pile, and drainage controls. The inspections will occur quarterly for the first two years and semi-annually thereafter for a minimum of thirty years. The frequency of inspections may be modified as appropriate based on site conditions (e.g. frequency of vandalism). Since construction completion, quarterly site inspections have taken place on: 10 December 2019, 19 February 2020, 16 June 2020, and 25 September 2020.

The long term monitoring procedure for the restored wetland area is detailed in *Appendix I: Wetland Restoration and Creation Plan* of the *Final (100%) Remedial Design for AOCs 1, 2 and 3* dated September 24, 2012. The restored wetland area will be monitored for the first three full growing seasons following completion, and then again during the fifth, seventh, and tenth growing seasons. During inspection and reporting years, the area will be inspected at least two times during the growing season (late spring and late summer). The monitoring plan includes the following activities:

- Late spring inspections of restored wetland area to observe and document potential erosion or soil disturbances, evidence of hydrology, wildlife browsing on planted species, invasive species, and conditions that necessitate corrective action;

- Late summer inspections of restored wetland area including vegetation coverage analysis, vegetation richness analysis, tree height measurement, survivability assessment, photographic documentation, identification of invasive species, and identification of conditions that necessitate corrective action. Late summer inspections on the third and fifth year of monitoring including evaluation of soils within the created wetland and documentation of the development of hydric soil characteristics; and

- Establishment and annual evaluation of four long-term wetland sampling plots to quantitatively assess wetland vegetation.

Since construction completion, the following wetlands inspections have taken place: September 2019 (late summer), June 2020 (late spring), and September 2020 (late summer).

Tables

Table 1 - Wetland Plantings
Pan Am Railways
Iron Horse Park, AOC 3, OU3, Billerica MA

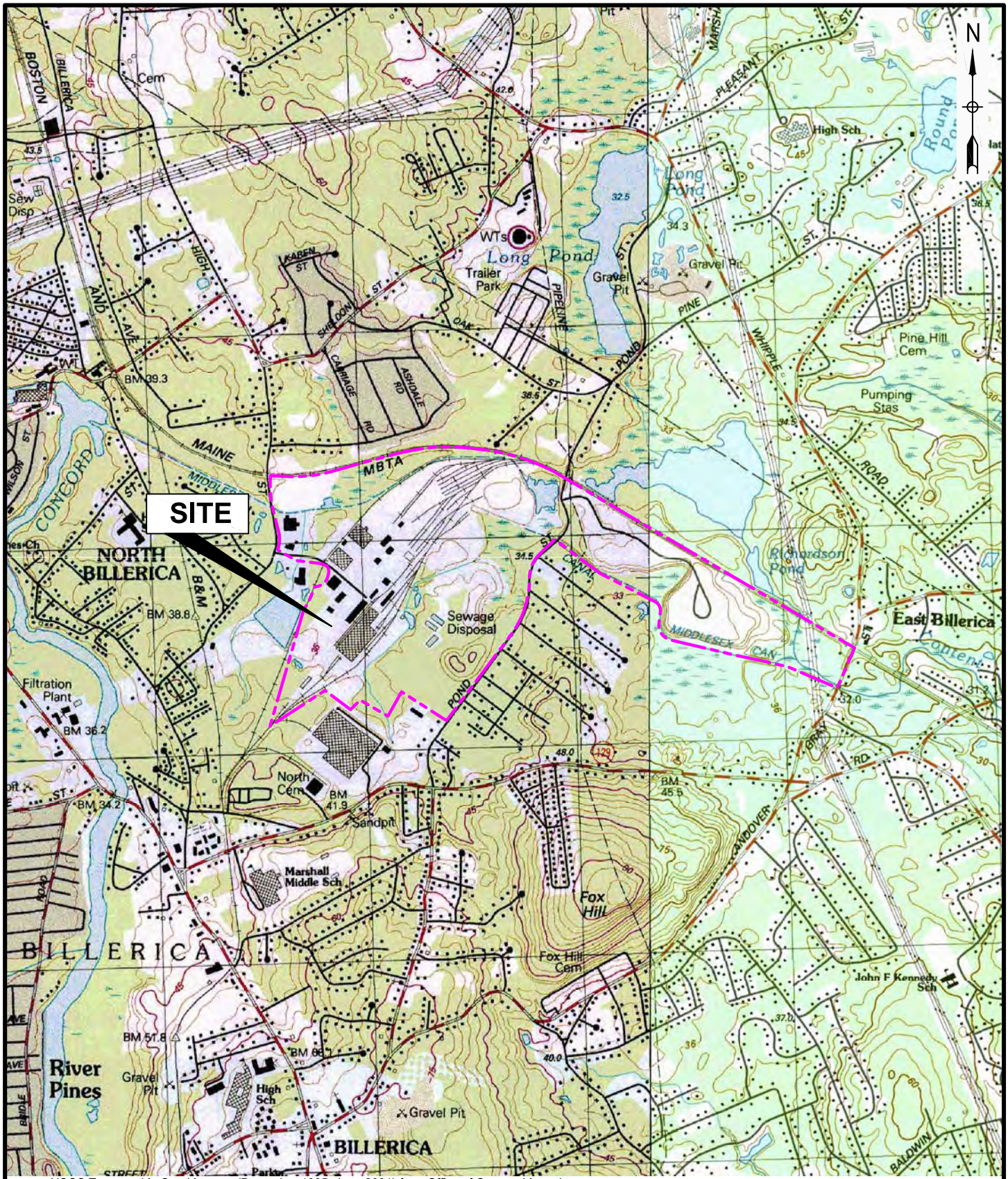
Common Name	Scientific Name	Quantity Planted
Elderberry	*Sambucus Canadensis*	20
Highbush Blueberry	*Vaccinium Corymbosum*	20
Speckled Alder	*Alnus Incana ssp. Rugosa*	45
Northern Arrowwood	*Viburnum Dentatum*	50
Red Maple	*Acer Rubrum*	15
Black Willow	*Salix Nigra*	15
Box Elder	*Acer Negundo*	50
Soft Rush	*Juncus Effusus*	450
Lurid Sedge	*Carex Lurida*	450
Fringed Sedge	*Carex Crinita*	100
Pickerelweed	*Pontederia Cordata*	100
Canada Rush	*Juncus Canadensis*	150
Sensitive Fern	*Onoclea Sensibilis*	50
Pussy Willow	*Salix Discolor*	38

Table 2 - Soil In-Place Testing
Pan Am Railways
Iron Horse Park, AOC 3, OU3, Billerica MA

	Comparison Criteria		
	ASTM D-1557 Result	**Min**	**Max**
Proctor	**-**	85%	**-**
Maximum dry density (lb/ft^3)	**130.2**	110.7	-
Optimum moisture (%)	**8%**	7%	11%

Date	ID	Dry Density (lb/ft^3)	Moisture Content	Proctor	Location Description
4/30/2019	1	114.8	7.9%	88.2%	Northeast corner of AOC 3A
4/30/2019	2	115.3	7.3%	88.6%	Southwest corner of AOC 3A
4/30/2019	3	112.5	8.4%	86.4%	Northeast corner of AOC 3B
4/30/2019	4	114.5	7.7%	87.9%	Northeast corner of AOC 3B
4/30/2019	5	114	7.8%	87.6%	North of center of AOC 3B
4/30/2019	6	109.7	7.9%	84.3%	North of center of AOC 3B
4/30/2019	7	114.9	7.6%	88.2%	Northwest corner of AOC 3B
4/30/2019	8	110.2	8.4%	84.6%	Northwest corner of AOC 3B
4/30/2019	9	113	8.0%	86.8%	Northwest corner of AOC 3B
4/30/2019	10	115.3	7.7%	88.6%	Northwest corner of AOC 3B
4/30/2019	11	111.3	7.5%	85.5%	Center of AOC 3B
4/30/2019	12	112.2	7.5%	86.2%	Center of AOC 3B
4/30/2019	13	112	7.7%	86.0%	North center of AOC 3B
4/30/2019	14	115	7.2%	88.3%	Northeast corner of AOC 3B
4/30/2019	15	115.7	8.1%	88.9%	Northeast corner of AOC 3B
4/30/2019	16	114.0	8.4%	87.6%	Southeast corner of AOC 3B
4/30/2019	17	112.6	8.0%	86.5%	Southeast corner of AOC 3B
4/30/2019	18	112.5	7.7%	86.4%	Southeast of the center of AOC 3B
4/30/2019	19	114.3	8.1%	87.8%	Southeast of the center of AOC 3B
4/30/2019	20	114.5	7.3%	87.9%	Southwest of the center of AOC 3B
4/30/2019	21	115.9	7.7%	89.0%	Southwest of the center of AOC 3B
4/30/2019	22	112.7	7.9%	86.6%	Southwest corner of AOC 3B
4/30/2019	23	115.5	8.0%	88.7%	Southwest corner of AOC 3B
4/30/2019	24	109.8	7.5%	84.3%	Southwest corner of AOC 3B
4/30/2019	25	114.0	7.3%	87.6%	Southwest corner of AOC 3B
4/30/2019	26	114.9	7.8%	88.2%	Southeast of the center of AOC 3B
4/30/2019	27	114.6	7.6%	88.0%	Southeast of the center of AOC 3B
4/30/2019	28	114.3	7.9%	87.8%	Southeast corner of AOC 3B
4/30/2019	29	114.7	8.2%	88.1%	Southeast corner of AOC 3B
4/30/2019	30	111.3	8.1%	85.5%	Southwest of the center of AOC 3B
4/30/2019	31	114.0	7.7%	87.6%	Southwest of the center of AOC 3B
4/30/2019	32	114.9	8.2%	88.2%	Center of AOC 3B

Figures



USGS Topographic Quad Images (December 1995, June 2001) from Office of Geographic and Environmental Information (MassGIS), Commonwealth of Massachusetts Executive Office of Energy and Environmental Affairs.

Scale 1:25,000

0.5 km 0 500 m

0.5 mi 0 1,000 ft

Legend

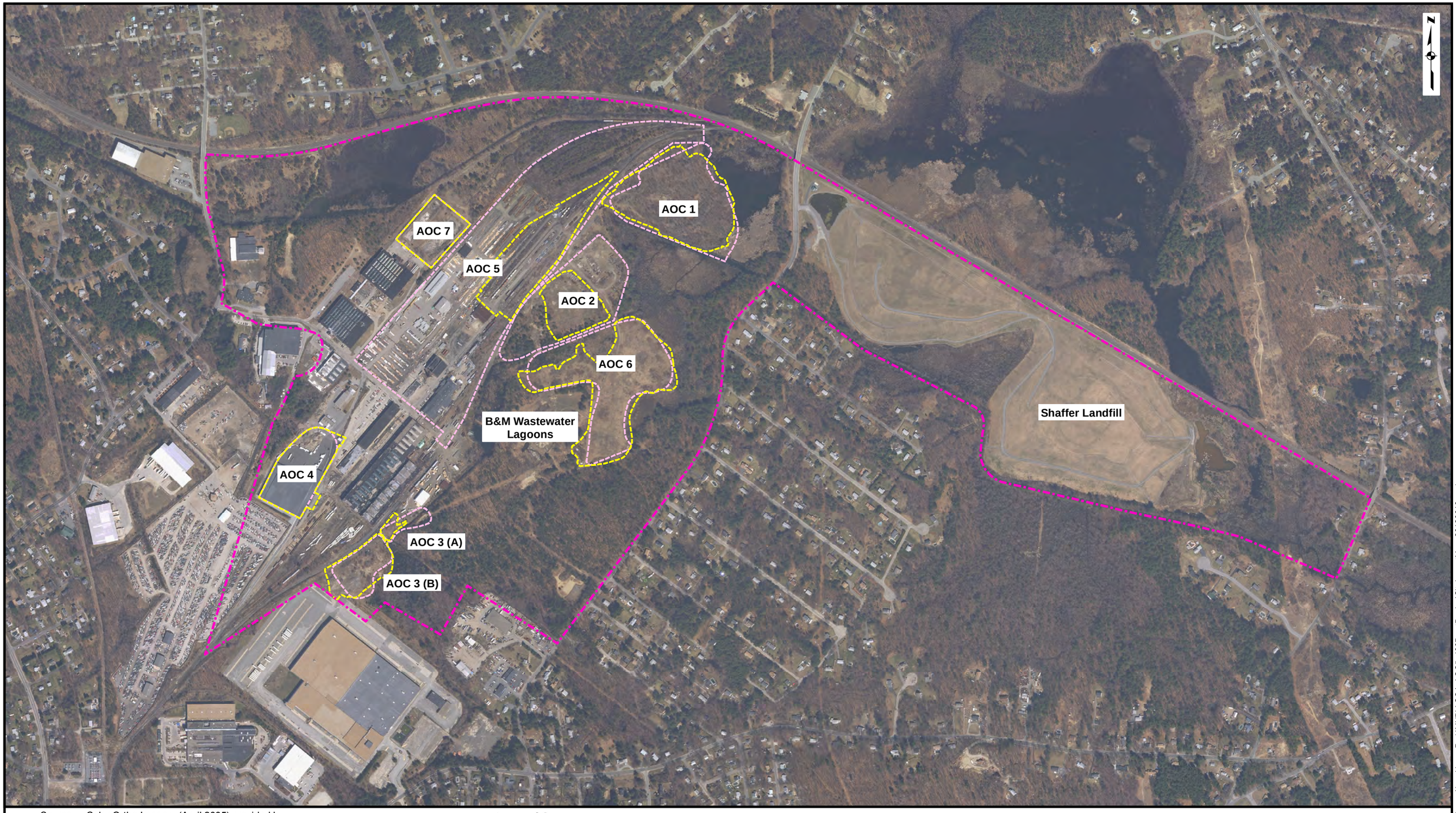
Iron Horse Site Boundary

Figure 1 - Site Location Map

Pan Am Railways
1700 Iron Horse Park
North Billerica, MA 01862

ERM

G:\Graphics\Clients\B_M\Iron Horse Park\CAD\AOC-4\AOC-4-Site Locus Map-2007.dwg (08/25/2009 - 9:53am Boston)



Source: Color Ortho Imagery (April 2005) provided by The Office of Geographic and Environmental Information (MassGIS), Commonwealth of Massachusetts Executive Office of Energy and Environmental Affairs.

Legend

- Iron Horse Park Site Boundary
- AOC Boundary (RD/RA, 2012)
- AOC Boundary (2004)

Areas of Concern

AOC 1	B&M Railroad Landfill	AOC 4	Old B&M Oil/Sludge Recycling Area
AOC 2	RSI Landfill	AOC 5	Contaminated Soils Area
AOC 3	B&M Locomotive Shop Disposal Areas (Areas A & B)	AOC 6	Asbestos Landfill
		AOC 7	Asbestos Lagoons

0 350 700 1,050 1,400 Feet

1:8,400

Figure 2 - Site Layout Map
Iron Horse Park Superfund Site
Operable Unit 3
Billerica, Massachusetts

ERM

G:\Graphics\Clients_L_P\Panam\Iron Horse Park\MXD\AOC4_AOC5_100PrcntDesign\SiteLayoutMap_20120618.mxd

Appendix A
Record Drawings

AS-BUILD DRAWINGS

IRON HORSE PARK SUPERFUND SITE
AOC 3
BILLERICA, MASSACHUSETTS

AUGUST 2019

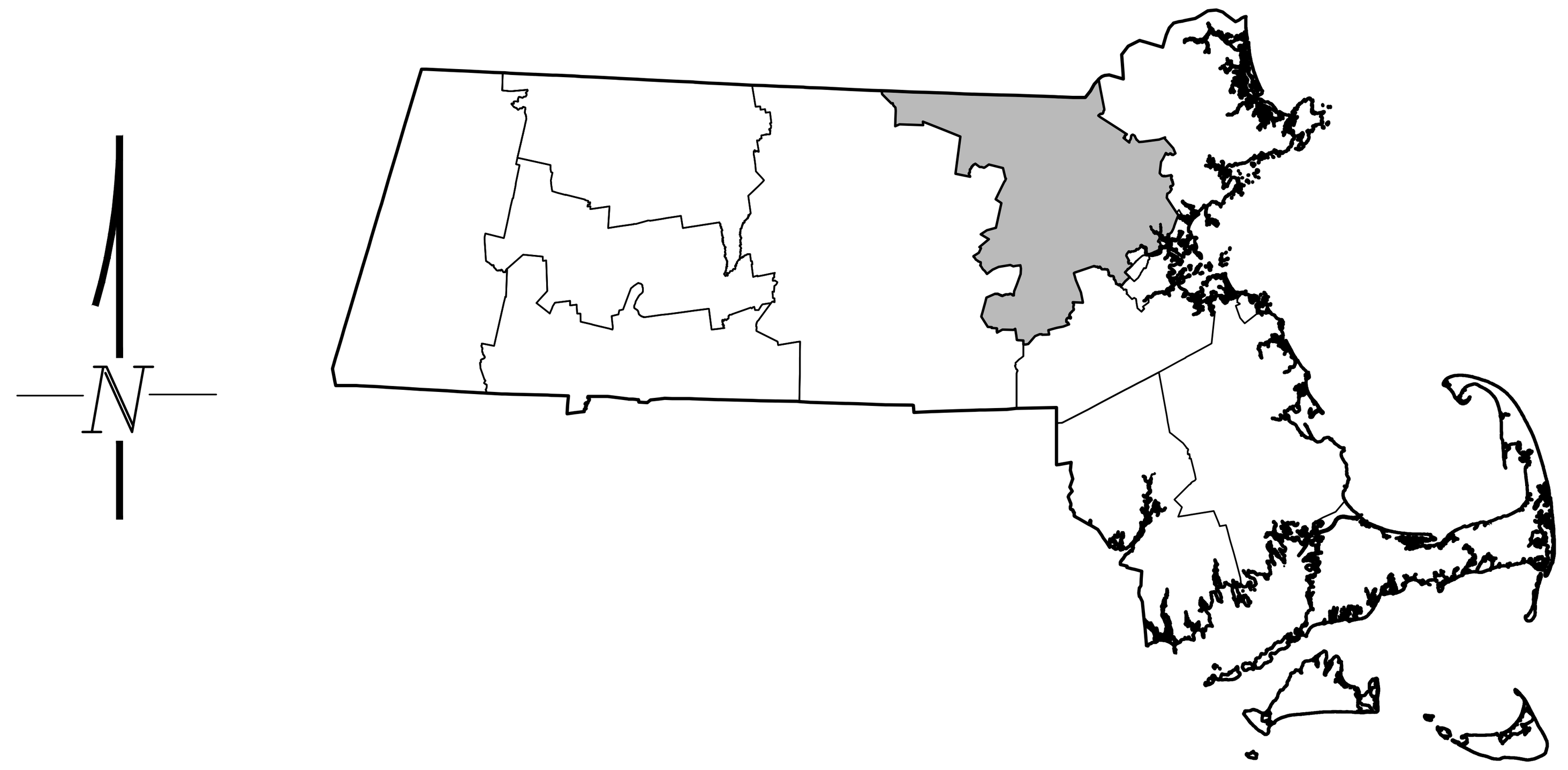
PREPARED FOR:

Pan Am Railways
1700 Iron Horse Park
North Billerica, MA 01862

STACEY BRAGA HARVEY, P.E.
Massachusetts Professional Engineer License No. 52938

PREPARED BY:

Environmental Resources Management
One Beacon Street, 5th Floor
Boston, Massachusetts 02108

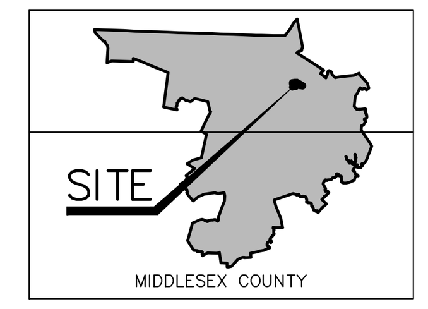


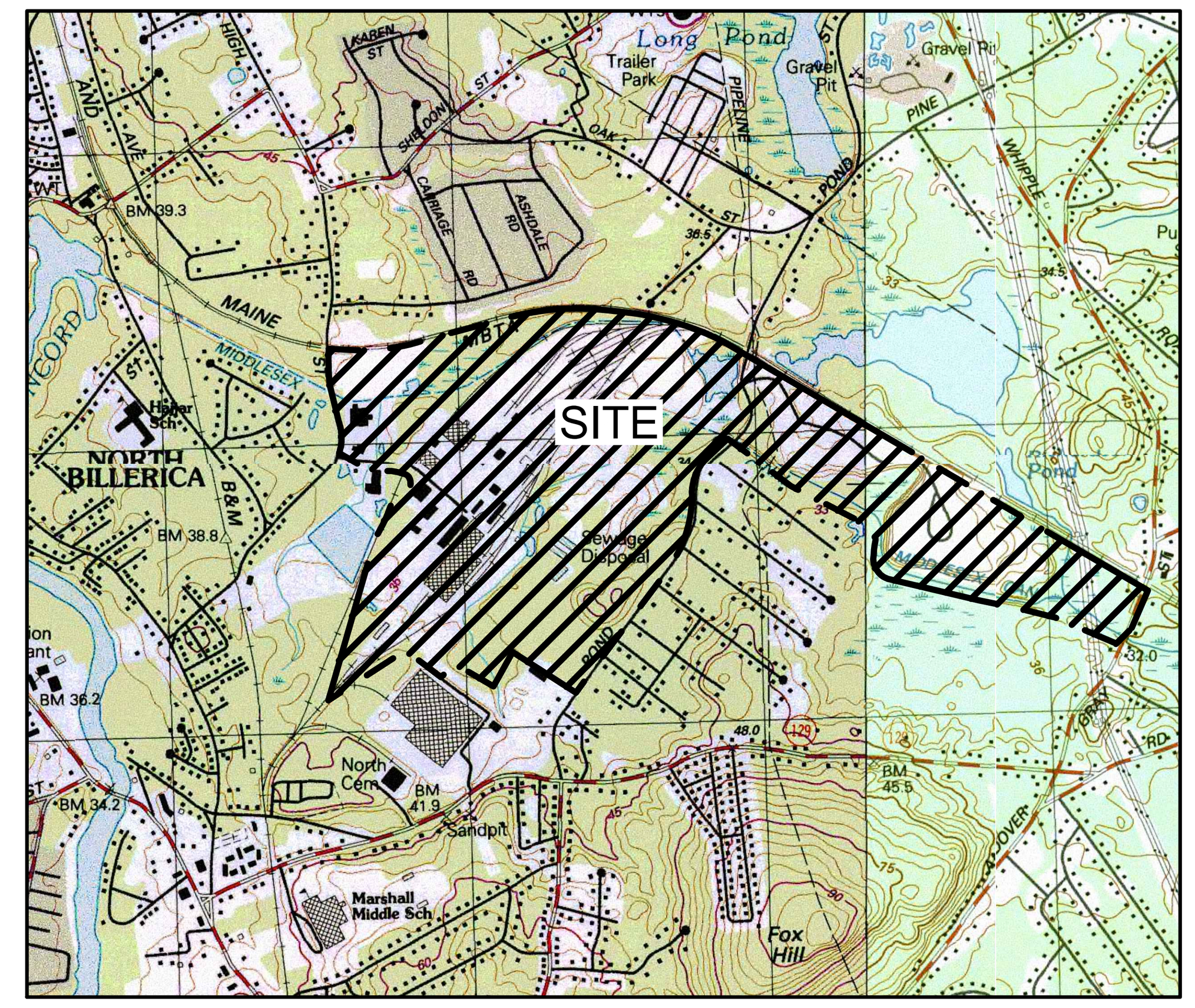
MIDDLESEX COUNTY MASSACHUSETTS

NOT TO SCALE

GENERAL NOTES

1. THE GENERAL NOTES AND LEGEND PROVIDED ON THIS DRAWING APPLY TO ALL DRAWINGS UNLESS OTHERWISE INDICATED.
2. SCALES ARE AS NOTED ON EACH DRAWING.
3. ELEVATIONS SHOWN ARE IN FEET ABOVE MEAN SEA LEVEL (MSL), NATIONAL GEODETIC VERTICAL DATUM 1929 (NGVD29). GRID COORDINATES REFER TO MASSACHUSETTS STATE PLANE COORDINATE SYSTEM (NAD83).
4. CONTOUR LINES SHOWN AT 1 FOOT INTERVALS UNLESS OTHERWISE INDICATED.
5. THE WETLAND BOUNDARIES PRESENTED ON THE SUBSEQUENT DRAWINGS WERE FIELD DELINEATED BY ERM ON 19–22 MAY 2009 AND 27 MAY 2010. THE B&M POND AND LIMIT OF WASTE WERE DELINEATED BY ERM DURING THE PRE-DESIGN INVESTIGATIONS IN 2009–2010. ALL OTHER EXISTING CONDITION INFORMATION SHOWN HEREIN IS BASED ON AN AERIAL SURVEY COMPLETED 24 APRIL 2009, PREPARED BY WSP SELLS, INC.
6. THE FEMA 100-YEAR FLOODPLAIN DELINEATION WAS OBTAINED FROM FLOOD INSURANCE RATE MAP (FIRM) 25017C0259E, MIDDLESEX COUNTY, DATED 4 JUNE 2010. THE ONLY PORTION OF THE SITE THAT IS SHOWN WITHIN THE FLOODPLAIN IS AOC 1; HOWEVER, THE FEMA 100-YR FLOODPLAIN SURVEY DOES NOT ACCOUNT FOR LANDFILL ACTIVITIES THAT HAVE OCCURRED WITHIN AOC 1 AND IS THEREFORE INACCURATE. THE FLOODPLAIN ELEVATION FOR THE PROJECT HAS BEEN DEFINED AS THE 109 FOOT CONTOUR IN THE NORTH AMERICAN VERTICAL DATUM 1988 (NAVD88), WHICH CORRESPONDS TO 109.8 FEET IN NGVD 29. ONLY THE 109.8 FOOT FLOODPLAIN ELEVATION IS PRESENTED IN THESE DRAWINGS.





720540.76E, 3038042.06N
NAD83 datum, Massachusetts State Plane Mainland Zone coordinate system.
USGS TOPOGRAPHIC QUAD for BILLERICA, MASSACHUSETTS, Source Year 1987

SITE LOCATION MAP

0 2000 4000
SCALE (IN FEET)

Image Source: Office of Geographic and Environmental Information (MassGIS), Commonwealth of Massachusetts Executive Office of Environmental Affairs

SITE VICINITY MAP

0 1000 2000
SCALE (IN FEET)

LIST OF DRAWINGS

DWG NO.	TITLE
1.	LOCATION MAPS, GENERAL NOTES, LIST OF DRAWINGS, ABBREVIATIONS, AND LEGEND
2.	GENERAL SITE PLAN
3.	AOC 3 EXISTING CONDITIONS
4.	AOC 3 SUBBASE GRADING
5.	AOC 3 FINAL CONDITIONS
6.	SHEET PILE PROFILES AND DETAILS
7.	CAP AND TRANSITION DETAILS
8.	GEOMEMBRANE PANEL LAYOUT

ABBREVIATIONS

℄	CENTERLINE
DIA.	DIAMETER
EX	EXISTING
TYP	TYPICAL
WSE	WATER SURFACE ELEVATION
LOW	LIMIT OF WASTE
MIN	MINIMUM
DWG	DRAWING
ELEV	ELEVATION
GAL	GALLONS
CY	CUBIC YARDS
AOC	AREA OF CONCERN
APPROX.	APPROXIMATE
B&M	BOSTON AND MAINE
E&SC	EROSION AND SEDIMENT CONTROL
NGVD29	NATIONAL GEODETIC VERTICAL DATUM 1929
NAVD88	NORTH AMERICAN VERTICAL DATUM 1988

LEGEND

EXISTING CONDITIONS

Symbol	Description
110	EXISTING INDEX CONTOUR (5' INTERVAL)
	EXISTING INTERMEDIATE CONTOUR (1' INTERVAL)
	IRON HORSE PARK SITE BOUNDARY
LOW	APPROXIMATE LIMIT OF WASTE (ERM DELINEATED)
	UNIMPROVED ROAD
	WETLAND
	OPEN WATER/STREAMS/PONDS
W W W	BORDERING VEGETATED WETLAND
	NON-JURISDICTIONAL STREAM
	MEAN ANNUAL HIGH WATER
	TREE LINE
X X	EXISTING FENCE
	100-FOOT BUFFER ZONE
E E	POWER TRANSMISSION LINE
	NATIONAL GRID TRANSMISSION POLE
	SYNCARPHA TRANSMISSION POLE
	RAILROAD TRACK
	100-YEAR FLOODPLAIN (109.8-FEET) (SEE GENERAL NOTE 6)

CONSTRUCTION/PROPOSED CONDITIONS

Symbol	Description
	LIMIT OF CAP
120	PROPOSED SUBBASE OR FINAL INDEX CONTOUR
122	PROPOSED SUBBASE OR FINAL INTERMEDIATE CONTOUR
W	WETLAND, BANK OR MEAN ANNUAL HIGH WATER BOUNDARY
X	FENCE
	ACCESS ROADWAY
SP	SHEET PILE
	EGRESS/INGRESS

1102 / 03 — DRAWING NUMBER WHERE DETAIL IS LOCATED; DETAIL DESIGNATION; DRAWING NUMBERS WHERE DETAIL IS IDENTIFIED

901 — DRAWING NUMBER WHERE DETAIL IS LOCATED; DETAIL DESIGNATION

DIRECTION OF SECTION VIEW

Rev.	Date	Description	By	Chk
0	8/28/2019	AS-BUILT DRAWING	PDD	MRL

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Environmental Resources Management

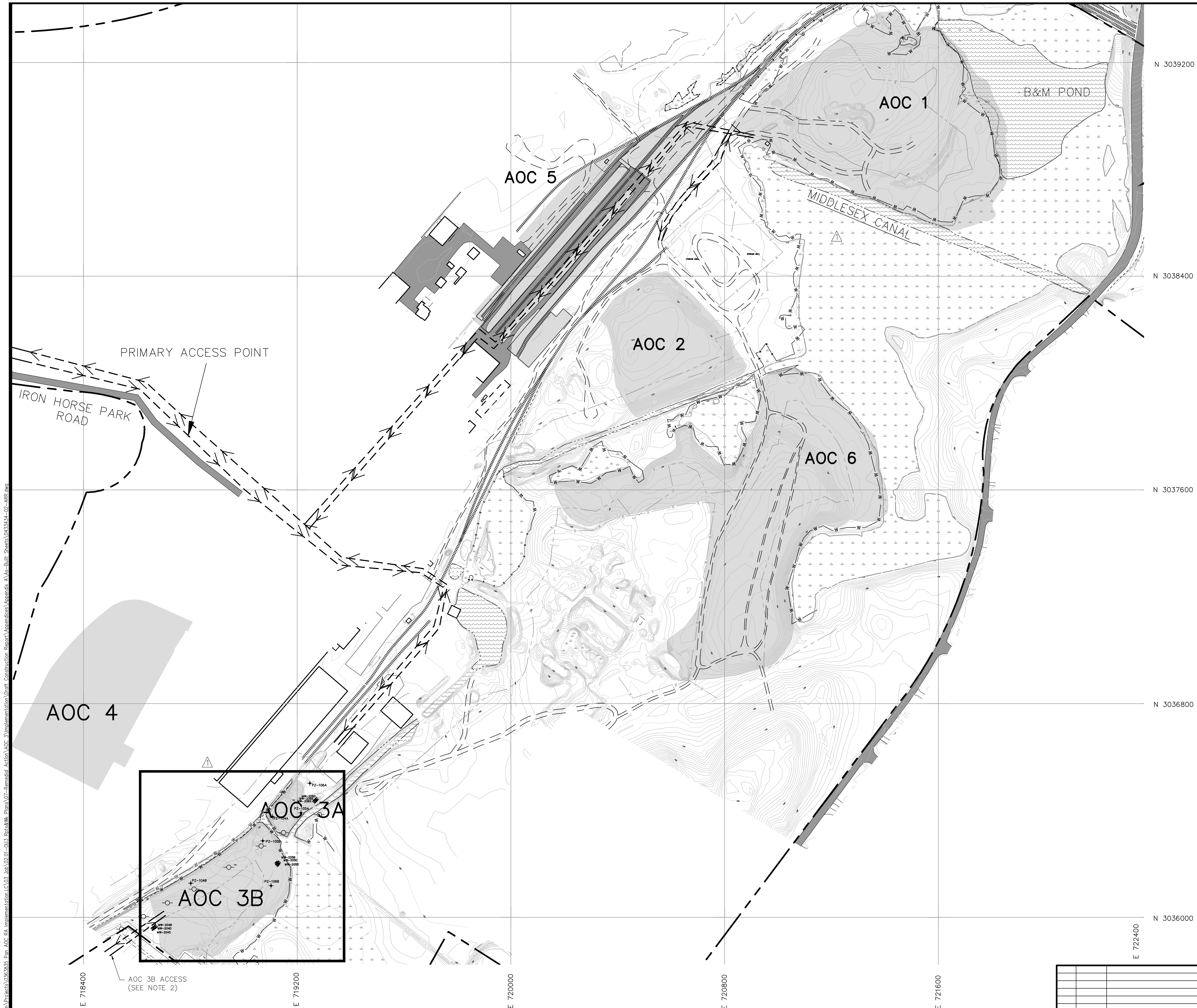
PAN AM RAILWAYS IRON HORSE PARK

BILLERICA, MASSACHUSETTS

LOCATION MAPS, GENERAL NOTES, LIST OF DRAWINGS, ABBREVIATIONS AND LEGEND

SCALE	PROJECT NUMBER	DRAWING	REV.
AS NOTED	0476110	01	0

DATE DRAWN 8/28/19



LEGEND

- NATIONAL GRID TRANSMISSION POLE
- SACARPHA TRANSMISSION POLE
- PAVED ROADS/PARKING
- UNIMPROVED ROADS
- EXISTING INDEX CONTOUR (5' INTERVAL)
- EXISTING INTERMEDIATE CONTOUR (1' INTERVAL)
- WETLAND
- OPEN WATER/STREAMS/PONDS
- BORDERING VEGETATED WETLAND
- NON-JURISDICTIONAL STREAM
- MEAN ANNUAL HIGH WATER
- IRON HORSE PARK SITE BOUNDARY
- AREA OF CONCERN
- LIMIT OF CAP
- EXISTING FENCE
- INGRESS/EGRESS
- 100-YEAR FLOODPLAIN (109.8-FEET)

NOTES:

1. SEE DRAWING NO. 01 FOR GENERAL NOTES, ABBREVIATIONS AND LEGEND.

2. THE SITE IS ACCESSIBLE VIA IRON HORSE PARK ROAD OFF HIGH STREET IN THE NORTHWEST. A SECONDARY ACCESS POINT IS LOCATED OFF POND STREET, TO BE USED ONLY AT THE APPROVAL OF THE ENGINEER. AOC 3B IS ACCESSIBLE VIA THE OFF-SITE PROPERTY IMMEDIATELY TO THE WEST IN ACCORDANCE WITH THE ACCESS AGREEMENT WITH THE ADJACENT LANDOWNER.

3. THE LIMITS OF WASTE FOR AOCS 3A AND 3B WERE DEFINED BY ERM BASED ON PRE-DESIGN INVESTIGATIONS. THE AREA OF CONCERN BOUNDARIES PRESENTED ARE SHOWN FOR VISUAL PURPOSES ONLY.

   THE CAPPED AREAS WITHIN THE LIMITS OF WASTE ASSOCIATED WITH AOC 3A AND 3B ARE PRESENTED BELOW:

   AOC 3 B&M LOCOMOTIVE SHOP DISPOSAL AREAS

PART A	APPROX 0.4 ACRES (LOW) AND 0.5 ACRES (CAP)
PART B	APPROX 3.6 ACRES (LOW) AND 2.8 ACRES (CAP)

Rev.	Date	Description	By	Chk
0	8/28/2019	AS-BUILT DRAWING	PDD	MRL

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Environmental Resources Management

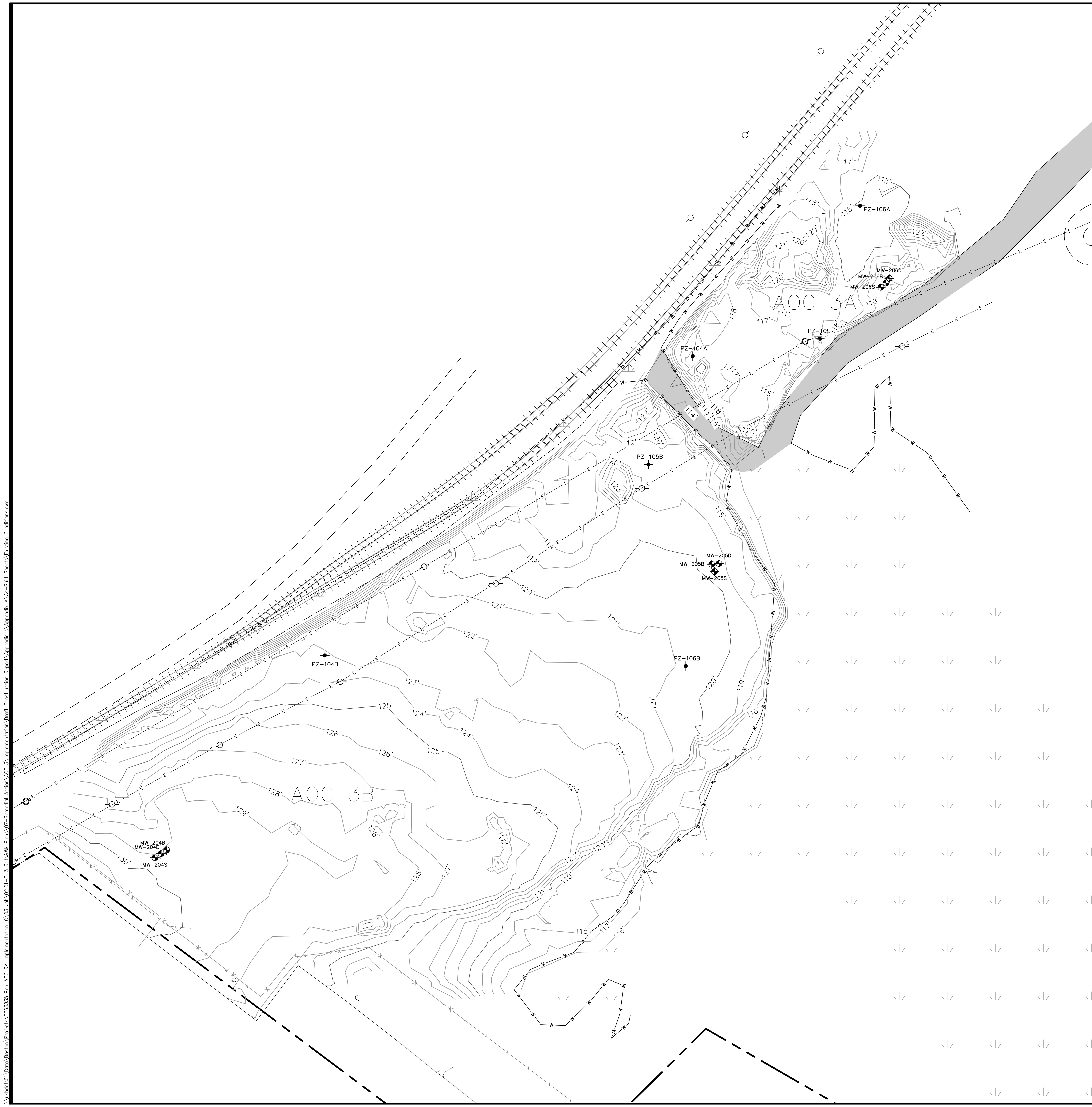
PAN AM RAILWAYS
IRON HORSE PARK

BILLERICA, MASSACHUSETTS

GENERAL SITE PLAN

SCALE	PROJECT NUMBER	DRAWING	REV.
AS NOTED	0476110	02	0

DATE DRAWN 8/28/19



N

0 40 80
SCALE (IN FEET)

LEGEND

- MONITOR WELLS
- NATIONAL GRID TRANSMISSION POLE
- SYNCARPHA TRANSMISSION POLE
- PIEZOMETER WELL
- RAILROAD
- INDEX CONTOUR (5' INTERVAL)
- INTERMEDIATE CONTOUR (1' INTERVAL)
- EXISTING WETLAND
- BORDERING VEGETATED WETLAND
- IRON HORSE PARK SITE BOUNDARY
- EXISTING FENCE
- EXISTING OPEN WATER/STREAMS/PONDS

NOTES:

1. SEE DRAWING NO. 01 FOR GENERAL NOTES, ABBREVIATIONS AND LEGEND.
2. AOC 3A IS PRIMARILY GRASS WITH SOME CONCRETE AND OTHER DEBRIS AT THE SURFACE. AOC 3B IS MOSTLY GRASS WITH SOME TREES. BOTH AREAS ARE BORDERED BY WETLANDS AND WATERWAYS, RAILROAD TRACKS AND PAVED PARKING AREAS.
3. THE GROUNDWATER TABLE IN THE AREA DISPLAYED IS APPROXIMATELY 112 TO 113 FEET ABOVE MEAN SEA LEVEL.
4. DEBRIS INCLUDES EXPOSED EMPTY DRUMS.

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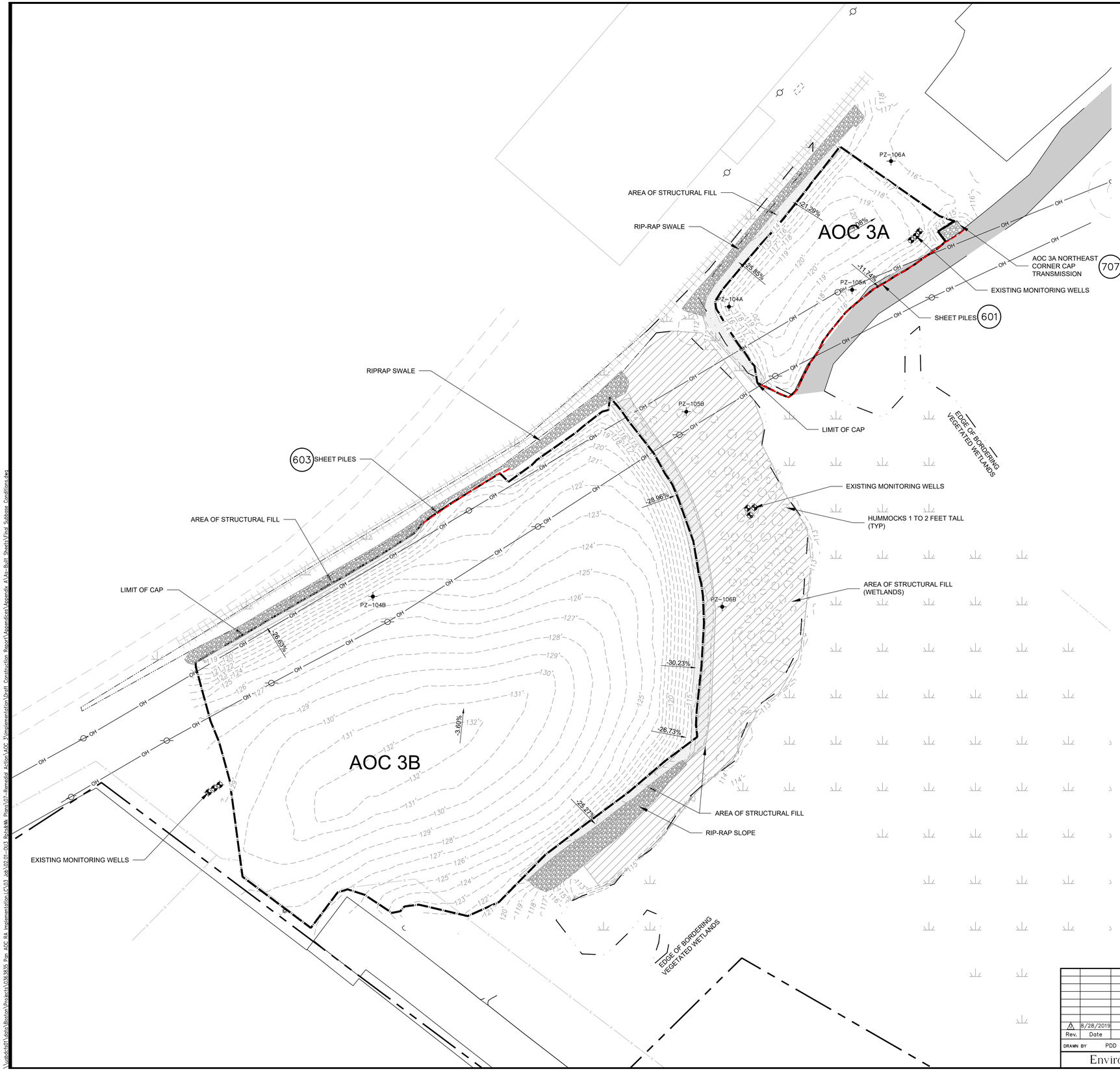
PAN AM RAILWAYS
IRON HORSE PARK
BILLERICA, MASSACHUSETTS

EXISTING CONDITIONS

SCALE	PROJECT NUMBER	DRAWING	REV.
AS NOTED	0476110	03	0
DATE DRAWN 8/28/19			



NOTES:

1. EXISTING STRUCTURES INCLUDING RAILROAD TRACKS, NATIONAL GRID POLES, SYNCARPHA ELECTRIC POLES WERE PROTECTED FROM DAMAGE.
2. WORK WAS PERFORMED IN ACCORDANCE WITH THE PROJECT WORK PLAN (PWP).
3. ALL PIEZOMETERS WITHIN THE LIMITS OF DISTURBANCE WERE ABANDONED IN PLACE. CONTRACTOR FILLED THE PIEZOMETERS WITH BENTONITE CHIPS AND THE PVC CASING WAS CUT FLUSH TO THE SURFACE. CONTRACTOR PERFORMED THIS WORK WITH DIRECT OVERSIGHT OF THE ENGINEER. ALL WELLS WITH THE LIMITS OF DISTURBANCE WERE PRESERVED AND PROTECTED THROUGHOUT CONSTRUCTION. CONTRACTOR WAS REQUIRED TO BOOT ALL WELLS WITH THE LIMITS OF CAP TO THE GEOMEMBRANE CAP.

Rev.	Date	Description	By	Chk
1	8/28/2019	AS-BUILT DRAWING	PDD	MRL

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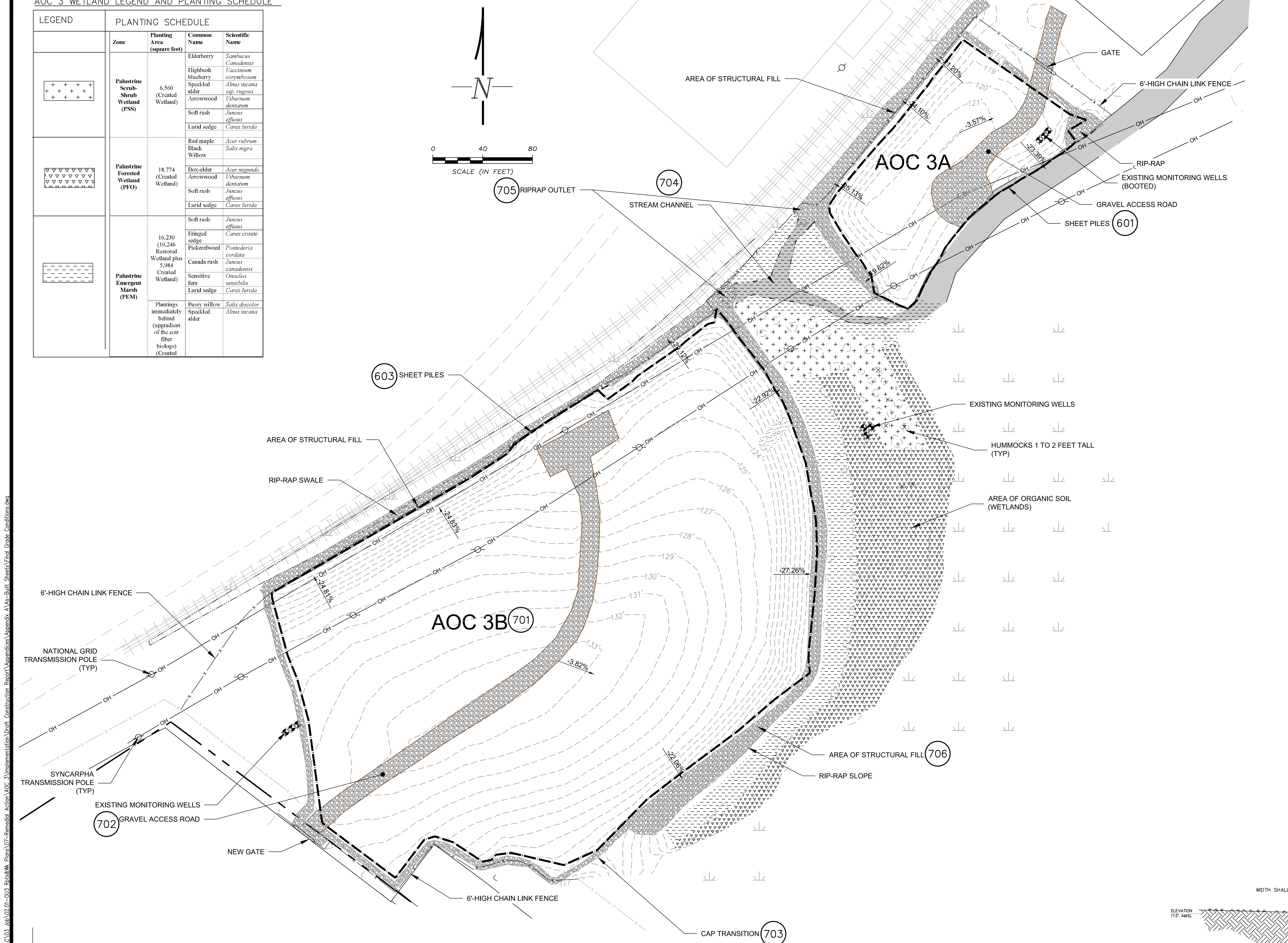
PAN AM RAILWAYS
IRON HORSE PARK
BILLERICA, MASSACHUSETTS

SUBBASE CONDITIONS

SCALE	PROJECT NUMBER	DRAWING	REV.
AS NOTED	0476110	04	0
DATE DRAWN 8/28/19			

AOC 3 WETLAND LEGEND AND PLANTING SCHEDULE

LEGEND	PLANTING SCHEDULE			
	Zone	**Planting Area (square feet)**	**Common Name**	**Scientific Name**
+ + + (PSS pattern)	**Palustrine Scrub-Shrub Wetland (PSS)**	6,560 (Created Wetland)	Elderberry	*Sambucus Canadensis*
			Highbush blueberry	*Vaccinium corymbosum*
			Speckled alder	*Alnus incana ssp. rugosa*
			Arrowwood	*Viburnum dentatum*
			Soft rush	*Juncus effusus*
			Lurid sedge	*Carex lurida*
▽ ▽ ▽ (PFO pattern)	**Palustrine Forested Wetland (PFO)**	18,774 (Created Wetland)	Red maple	*Acer rubrum*
			Black Willow	*Salix nigra*
			Box-elder	*Acer negundo*
			Arrowwood	*Viburnum dentatum*
			Soft rush	*Juncus effusus*
			Lurid sedge	*Carex lurida*
- - - (PEM pattern)	**Palustrine Emergent Marsh (PEM)**	16,230 (10,246 Restored Wetland plus 5,984 Created Wetland)	Soft rush	*Juncus effusus*
			Fringed sedge	*Carex crinite*
			Pickerelweed	*Pontederia cordata*
			Canada rush	*Juncus canadensis*
			Sensitive fern	*Onoclea sensibilis*
			Lurid sedge	*Carex lurida*
		Plantings immediately behind (upgradient of the coir fiber biologs) (Created	Pussy willow	*Salix discolor*
			Speckled alder	*Alnus incana*

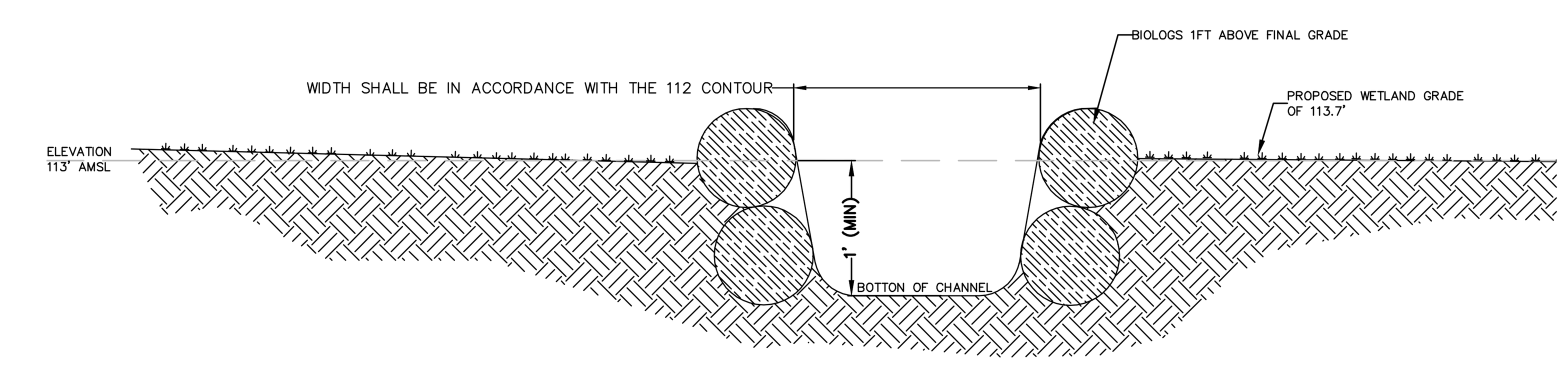


CONSTRUCTION NOTES (FOR AOC 3):

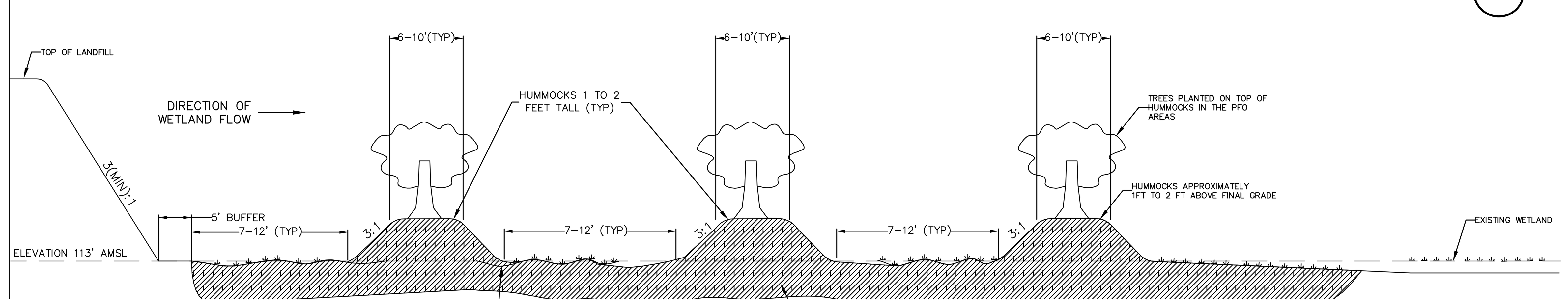
1. FINAL GRADING INCLUDES CREATION OF PLANTABLE HUMMOCKS AS DEPICTED ON DETAIL ON THIS DRAWING, AND OTHER MICROTOPOGRAPHY AS DIRECTED BY THE ENGINEER'S WETLAND RESTORATION SPECIALIST. MICROTOPOGRAPHY WAS CREATED BY LEAVING THE ORGANIC SOIL LOOSE AND NOT CREATING A SMOOTH SURFACE AT THE FINAL ELEVATION OF THE WETLAND. HUMMOCKS SIZE AND SPACING SHOWN ON THIS DRAWING ARE REPRESENTATIVE TO DEMONSTRATE THE VARIABLENESS.
2. WOODY PLANT MATERIALS WERE INSTALLED IN CLUSTERS ON TOP OF HUMMOCK SURFACE TO SIMULATE NATURAL DISTRIBUTION PATTERNS AND GROWTH HABITATS AS DETERMINED IN THE FIELD BY THE ENGINEER'S WETLAND RESTORATION SPECIALIST. HUMMOCKS WITHIN THE PFO PLANTING ZONE WERE PLANTED WITH A COMBINATION OF TREES AND SHRUBS. NO TREES WERE PLANTED WITHIN 15 FEET OF THE BASE OF THE ENGINEERED CAP.
3. WETLAND AREAS WITHIN THE LIMIT OF DISTURBANCE WERE SEEDED WITH NEW ENGLAND WETLAND SEED MIX (18 LBS/ACRE) AND NEW ENGLAND EROSION CONTROL/RESTORATION MIX FOR DETENTION BASINS AND MOIST SITES (9 LBS/ACRE).
4. HUMMOCKS CONSTRUCTION INCLUDED STRUCTURAL FILL AT ELEVATIONS BELOW THE TOP 12 INCHES OF ORGANIC SOIL.

LEGEND

- EXISTING MONITOR WELLS
- NATIONAL GRID TRANSMISSION POLE
- SYNCARPHA TRANSMISSION POLE
- PIEZOMETER WELL
- TRANSMISSION LINE
- SHEET PILES
- RAILROAD
- INDEX CONTOUR (5' INTERVAL)
- INTERMEDIATE CONTOUR (1' INTERVAL)
- EXISTING WETLAND
- IRON HORSE PARK SITE BOUNDARY
- EXISTING OPEN WATER/STREAMS/PONDS
- LIMIT OF CAP



TYPICAL STREAM CHANNEL CROSS SECTION
(NOT TO SCALE)



TYPICAL WETLAND CROSS SECTION
(NOT TO SCALE)

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1	8/28/2019	AS-BUILT DRAWING	PDD	MRL

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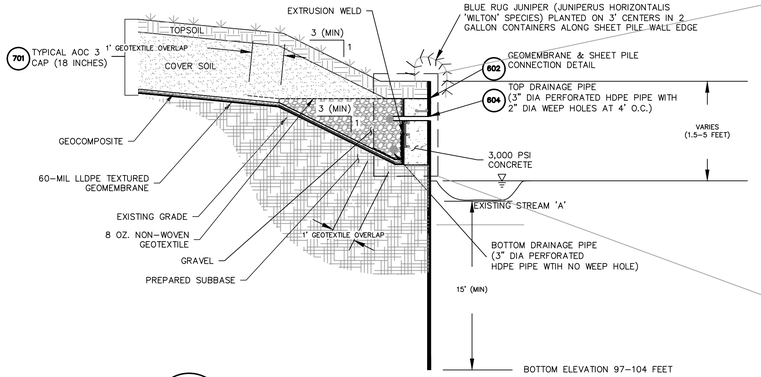
PAN AM RAILWAYS
IRON HORSE PARK
BILLERICA, MASSACHUSETTS

FINAL CONDITIONS

SCALE	PROJECT NUMBER	DRAWING	REV.
AS NOTED	0476110	05	0

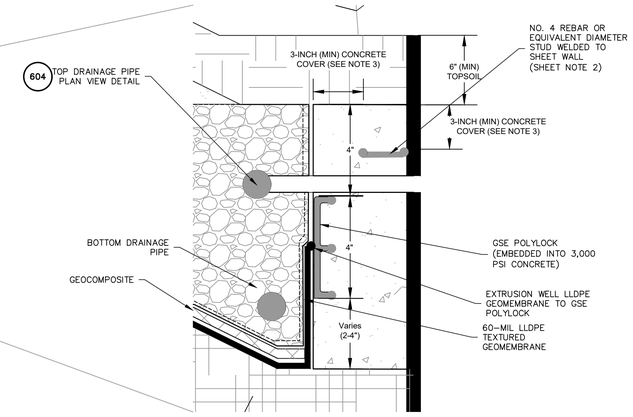
DATE DRAWN 8/28/19



601 / 04 AOC-3A TYPICAL SHEET PILE DETAIL

NOTES:

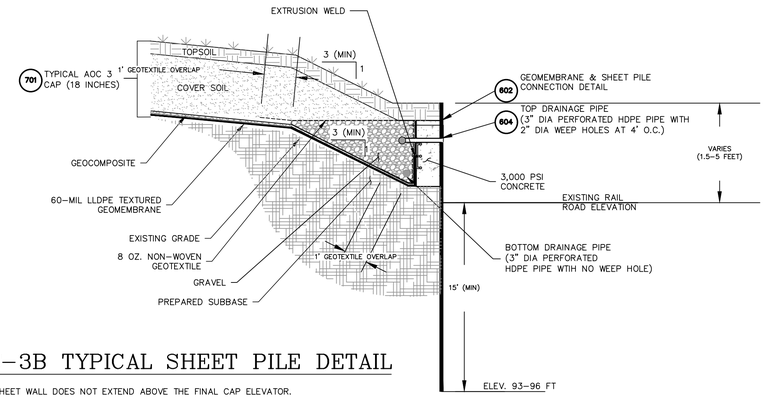
1. THE TOP AND BOTTOM DRAINAGE PIPE ONLY APPLIES FOR THE SHEETPILE FOR AOC 3A. AOC 3B SHEETPILE ONLY HAS ONE DRAINAGE PIPE AT THE BOTTOM OF THE COVER SYSTEM.
2. EMBEDMENT DEPTH OF THE GSE POLYLOCK IS 1-INCH.



602 / 05 GEOMEMBRANE & SHEET PILE CONNECTION DETAIL

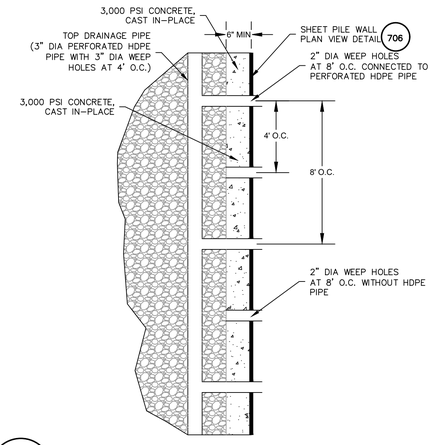
NOTES:

1. THIS DETAIL IS SHOWN FOR AOC-3A, HOWEVER, IT ALSO APPLIES TO AOC-3B.
2. THE REBAR STUD IS WELDED BETWEEN WEEP HOLES TO THE LOCK PANEL OF WALL. THE BAR IS APPROXIMATELY PLACED AT A SPACING OF 4 FEET ON CENTER.
3. THE REBAR ON STUD HAS A MINIMUM OF 3 INCHES OF CONCRETE COVER IN ALL DIRECTIONS.



603 / 04 AOC-3B TYPICAL SHEET PILE DETAIL

NOTE:
1. THE SHEET WALL DOES NOT EXTEND ABOVE THE FINAL CAP ELEVATOR.



604 / 05 TOP DRAINAGE PIPE PLAN VIEW DETAIL

NOTE:
1. TOP DRAINAGE PIPE PROTRUDES A MINIMUM OF 3 INCHES THROUGH THE SHEET PILE WALL.

Rev.	Date	Description	By	Chk
1	8/28/2019	AS-BUILT DRAWING	PDD	MRL

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Environmental Resources Management

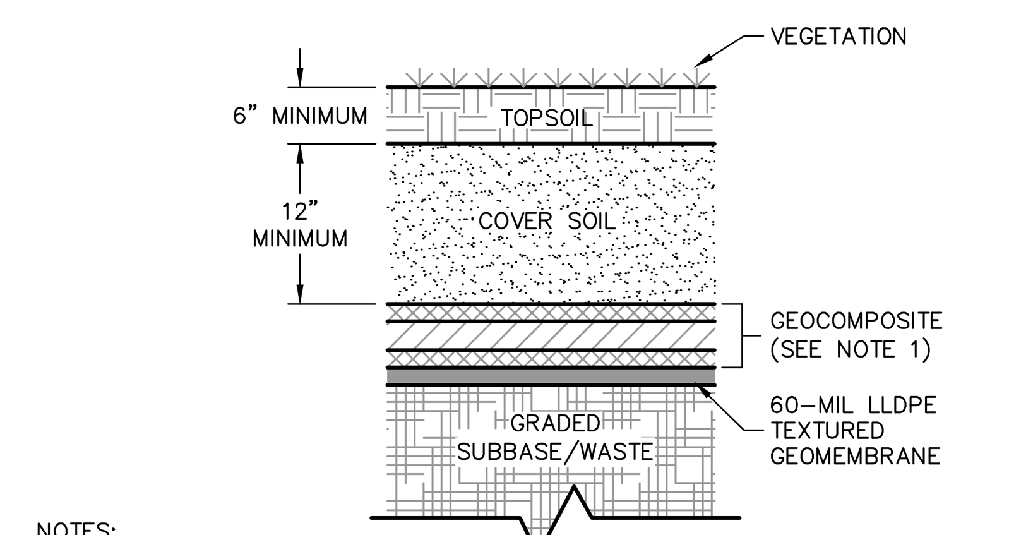
PAN AM RAILWAYS
IRON HORSE PARK
BILLERICA, MASSACHUSETTS

SHEET PILE PROFILES AND DETAILS

SCALE	PROJECT NUMBER	DRAWING	REV.
AS NOTED	0476110	06	0

DATE DRAWN 8/28/19

\\nabdc01\data\Boston\Projects\0363835 Pan AOC RA Implementation\CV\03 sb\V02.01-003 Plots&Mk Plans\07-Remedial Action\AOC 3\Implementation\Pan Construction Report\Appendices\Appendix A\As-Built Sheets\0433434-05-ARR.dwg

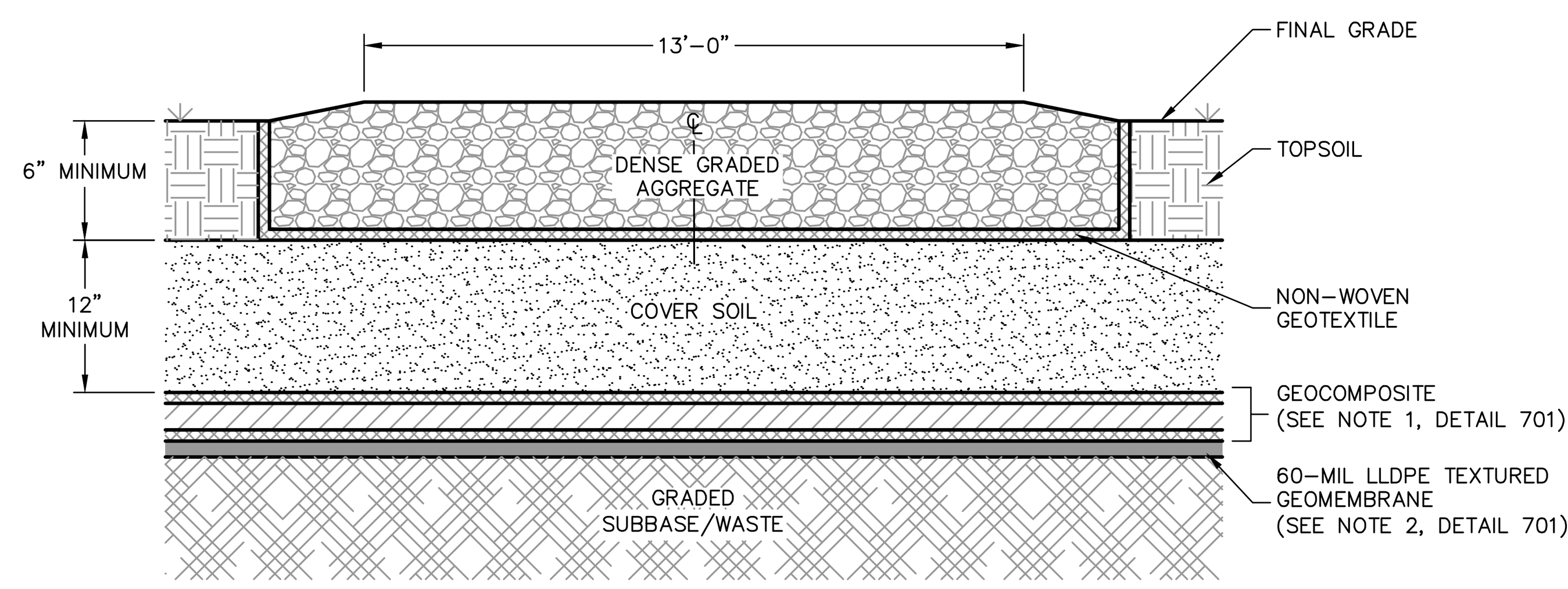


NOTES:

1. GEOCOMPOSITE COMPOSED OF TWO NON-WOVEN GEOTEXTILES HEAT BONDED TO A GEONET CORE.
2. GEOMEMBRANE SEAMS WELDED AND LEAK-PROOF IN ACCORDANCE WITH THE TECHNICAL SPECIFICATIONS.

701 / 05 AOC 3A & 3B CAP DETAIL

NOT TO SCALE

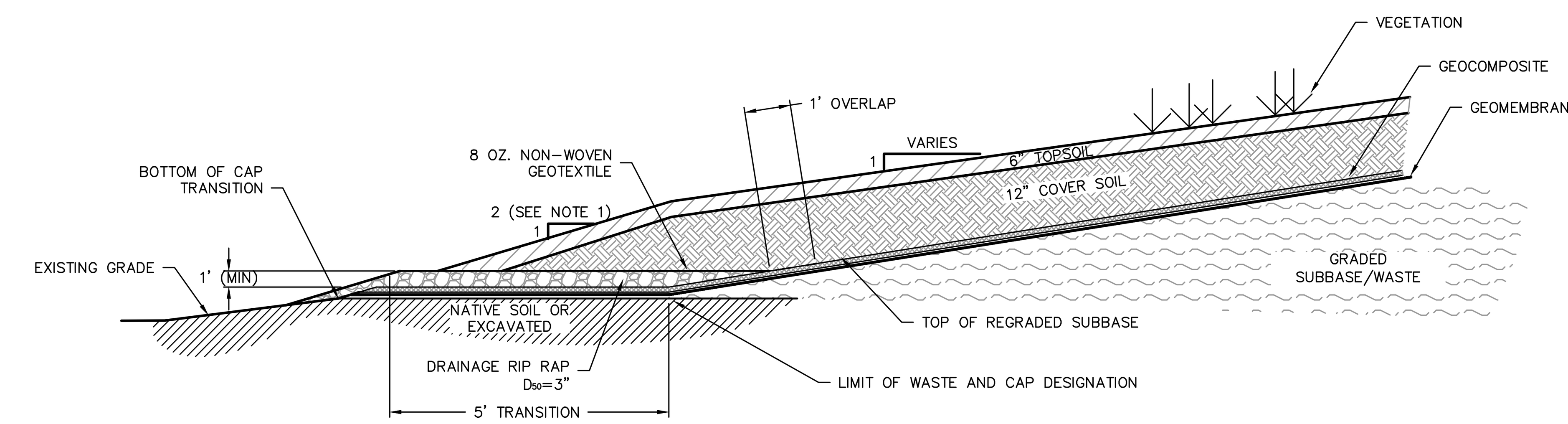


NOTES:

1. ACCESS ROAD FOLLOWS THE SLOPE OF THE FINAL GRADE, BUT DOES NOT EXCEED 15%.
2. PITCH OF THE ROAD FROM THE CENTERLINE IS 1%.

702 / 05 TYPICAL ACCESS ROAD DETAIL

NOT TO SCALE

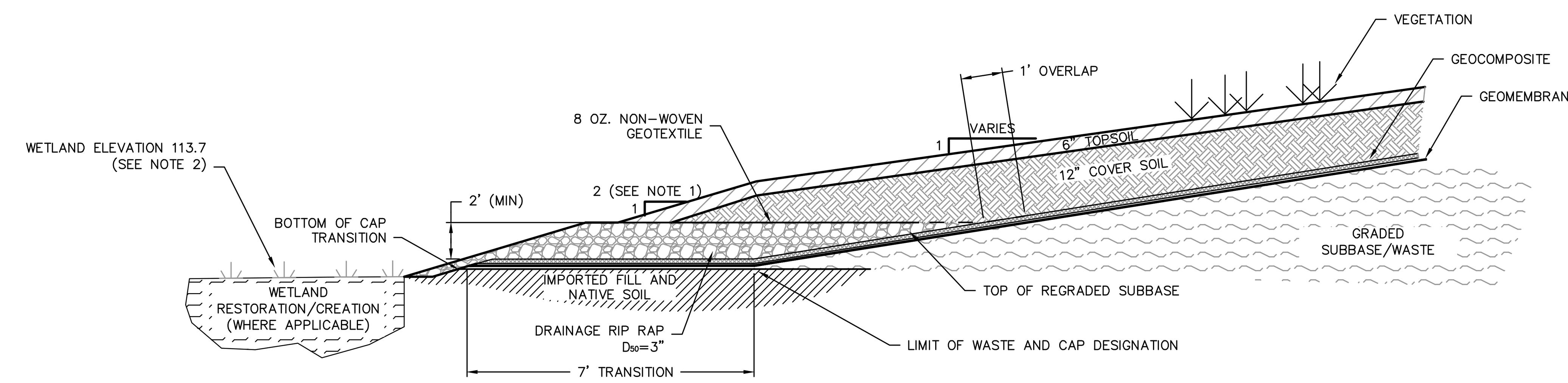


NOTE:

1. IN AREAS WHERE THE SUBBASE GRADE SIDE SLOPE IS 3:1 AT THE PERIMETER, THE TRANSITION REMAINS AT A 3:1 SLOPE THEREFORE, THERE IS A 5.5-FOOT LONG TRANSITION. IN AREAS FLATTER THAN 3:1 AT THE PERIMETER, THE TRANSITION IS 2:1.

703 / 05 AOC 3 PERIMETER CAP TRANSITION DETAIL

NOT TO SCALE

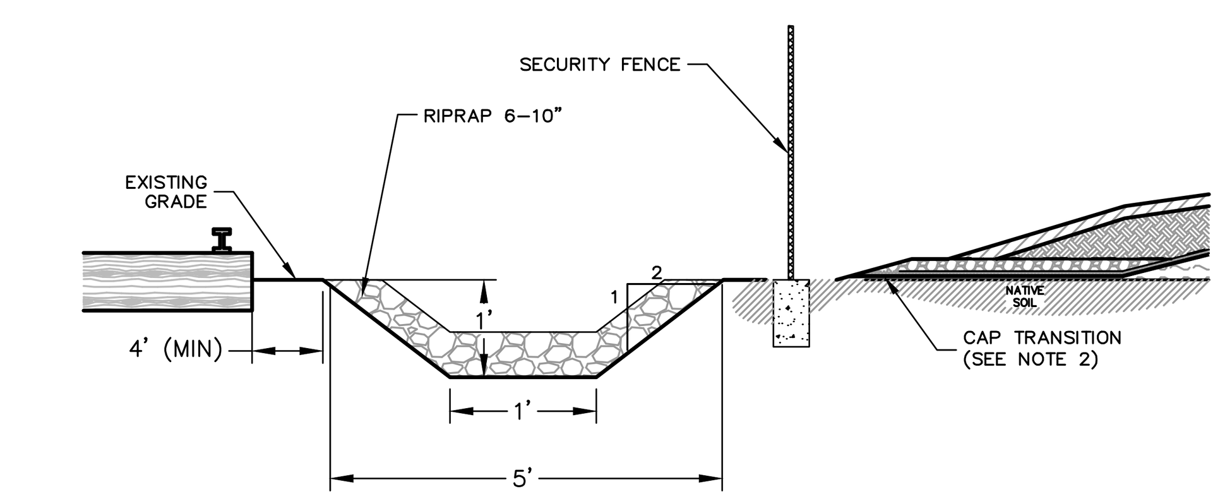


NOTE:

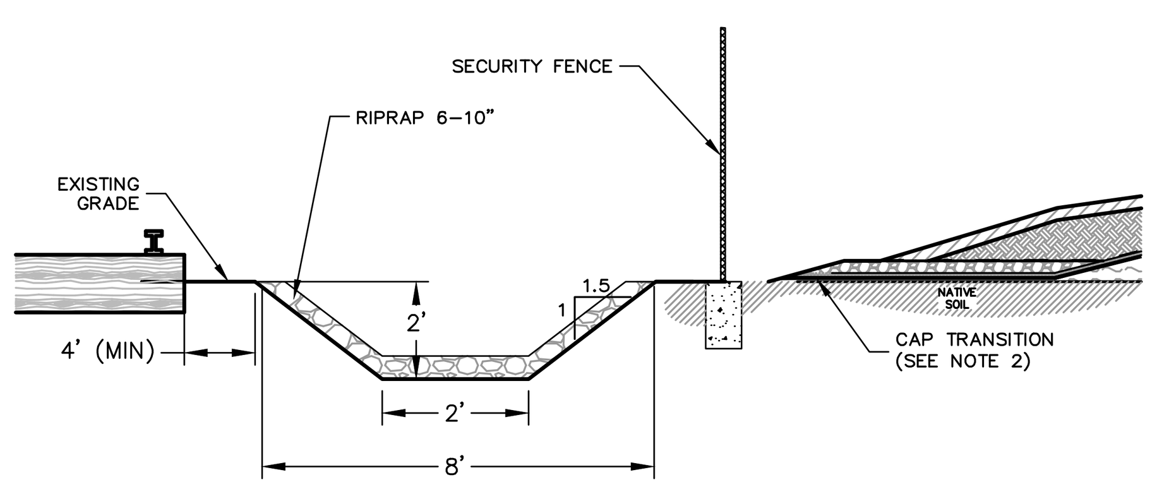
1. IN AREAS WHERE THE SUBBASE GRADE SIDE SLOPE IS 3:1 AT THE PERIMETER, THE TRANSITION REMAINS AT A 3:1 SLOPE. THEREFORE, THERE IS A 5.5-FOOT LONG TRANSITION. IN AREAS FLATTER THAN 3:1 AT THE PERIMETER, THE TRANSITION IS 2:1.
2. ELEVATION OF THE GEOMEMBRANE AT THE LIMITS OF THE CAP IS A MINIMUM OF FOOT ABOVE THE HIGH WATER ELEVATION OF 113.7 FT AMSL.

706 / 05 AOC 3 PERIMETER CAP TRANSITION INTO WETLAND/STREAM DETAIL

NOT TO SCALE



NORTH SWALE PROFILE



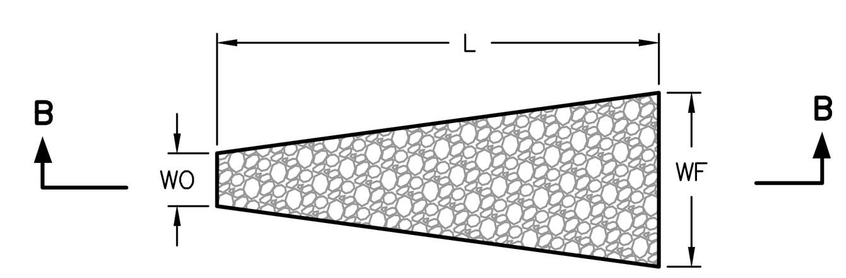
DRAINAGE SWALE PROFILE

NOTES:

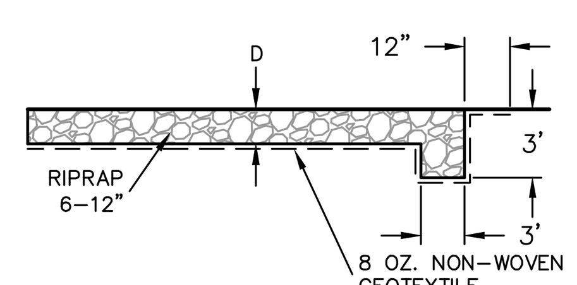
1. AOC 3 NORTH SWALE HAS A GRADIENT OF 1% TYPICAL. AOC 3 SOUTH SWALE HAS A GRADIENT OF 1% MINIMUM AND 2% MAXIMUM.
2. THE ELEVATION OF THE DRAINAGE RIP RAP IS AT OR ABOVE THE TOP OF THE SWALE.

704 / 05 TYPICAL AOC 3 SWALE DETAILS

NOT TO SCALE



PLAN VIEW

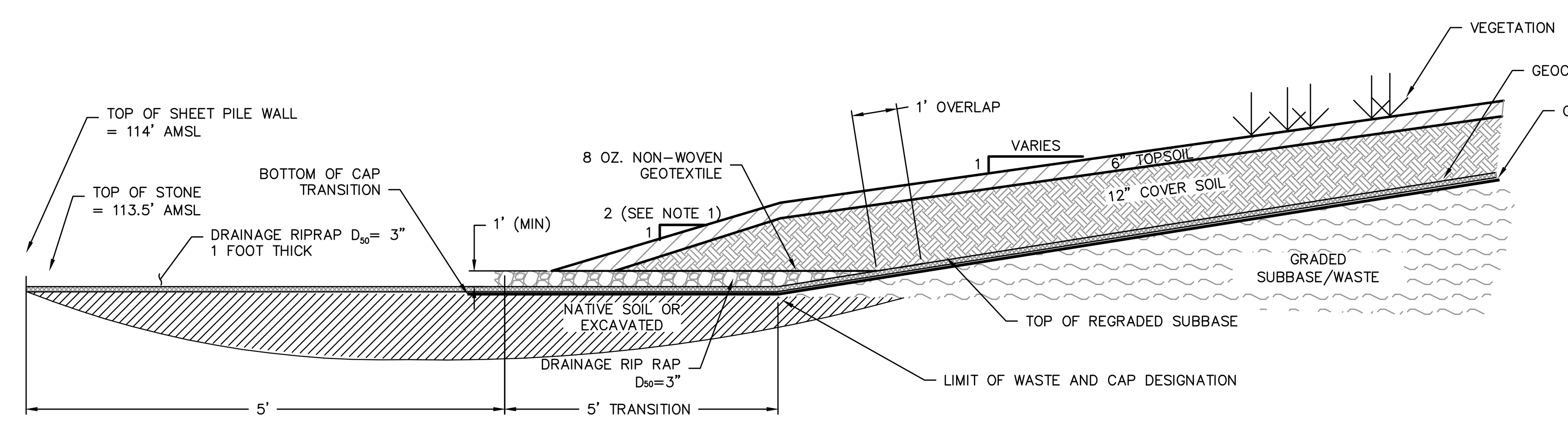


SECTION B-B

SWALE	THICKNESS D (in)	LENGTH L (ft)	START WIDTH WO (ft)	FINAL WIDTH WF (ft)
NORTH	18	6	6	12
SOUTH	18	19	12.5	20

705 / 05 AOC 3 NORTH AND SOUTH SWALE OUTLET PROTECTION

NOT TO SCALE



NOTE:

1. IN AREAS WHERE THE SUBBASE GRADE SIDE SLOPE IS 3:1 AT THE PERIMETER, THE TRANSITION SHALL REMAIN AT A 3:1 SLOPE THEREFORE, THERE IS A 5.5-FOOT LONG TRANSITION. IN AREAS FLATTER THAN 3:1 AT THE PERIMETER, THE TRANSITION SHALL BE 2:1.

707 / 06 AOC 3A NORTHEAST CORNER CAP TRANSITION

NOT TO SCALE

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0	8/28/2019	AS-BUILT DRAWING	PDD	MRL

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Environmental Resources Management

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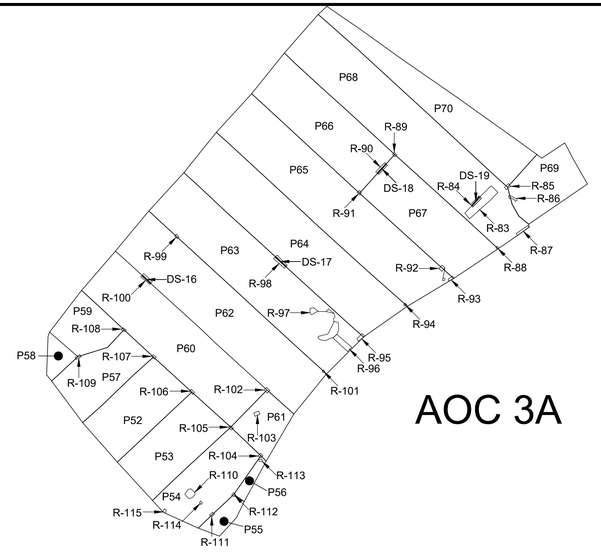
PAN AM RAILWAYS
IRON HORSE PARK
BILLERICA, MASSACHUSETTS

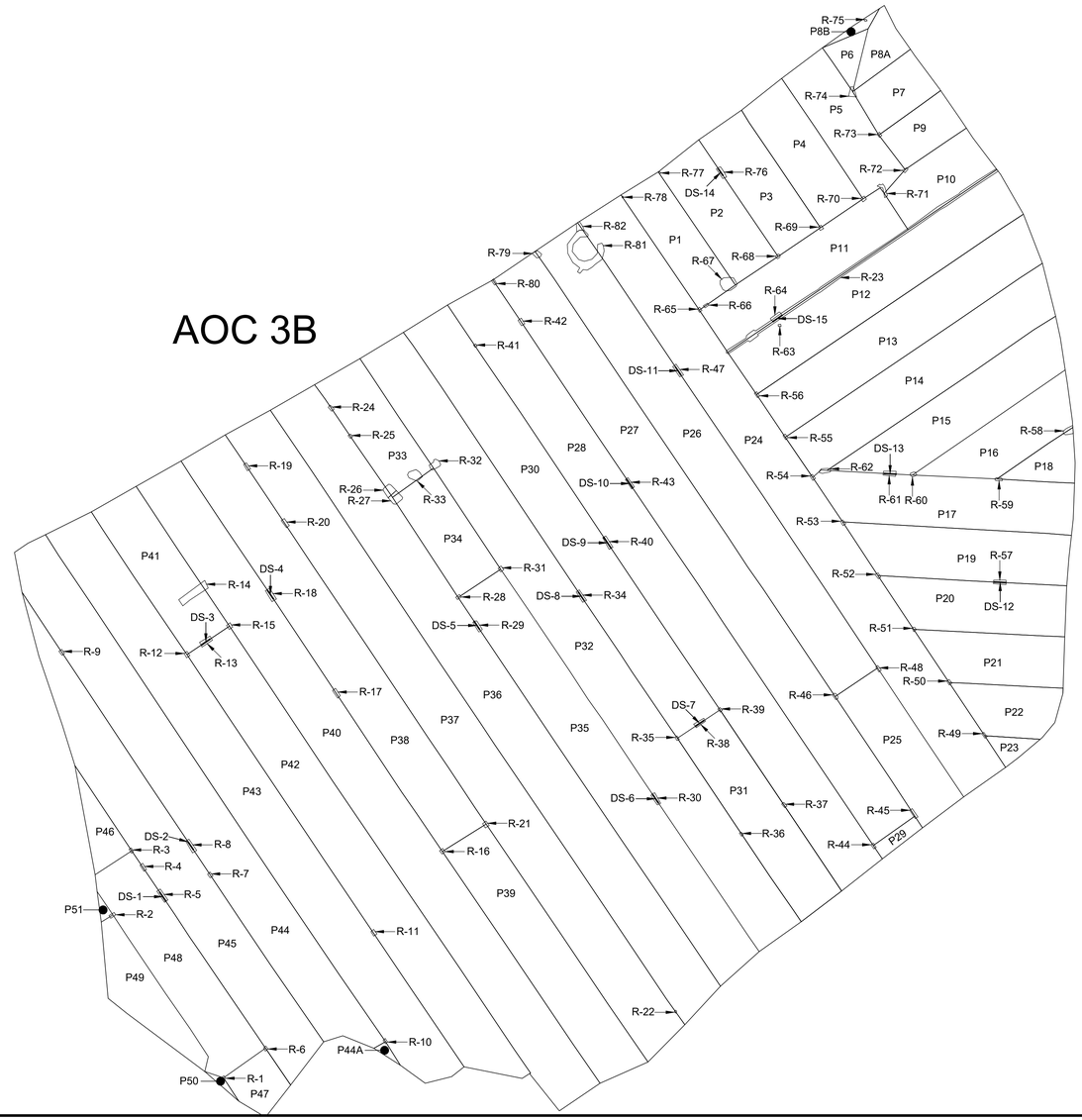
CAP AND TRANSITION DETAILS

SCALE	PROJECT NUMBER	DRAWING	REV.
AS NOTED	0476110	07	0

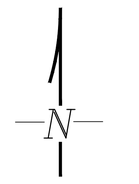
DATE DRAWN 8/28/19



AOC 3A



AOC 3B



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1	8/28/2019	AS-BUILT DRAWING	PDD	MRL

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PAN AM RAILWAYS
IRON HORSE PARK
BILLERICA, MASSACHUSETTS

GEOMEMBRANE PANEL LAYOUT

SCALE	PROJECT NUMBER	DRAWING	REV.
AS NOTED	0476110	08	0

DATE DRAWN 8/28/19

Appendix B
Photo History

Photograph: *1*	*Site Clearance: AOC 3B*
9/13/2018	

Photograph: *2*	*Tree Chipping for Offsite Disposal*
9/13/2018	

Photograph: *3*	*Super Silt Fence Installation*
9/20/2018	

Photograph: *4*	*Check Dam in Stream A*
9/26/2018	

Photograph: *5*	*Test Trench on AOC 3B*
10/1/2018	

Photograph: *6*	*Temporary Stream Crossing*
10/4/2018	

Photograph: *7*	*Super Sand Sack Berm*
10/10/2018	

Photograph: *8*	*Typical Dewatering Sump*
10/17/2018	

Photograph: *9*	*Mass Excavation: AOC 3B*
10/17/2018	

Photograph: *10*	*Subgrading: AOC 3B*
10/17/2018	

Photograph: *11*	*Sheet Pile Installation: AOC 3B*
10/24/2018	

Photograph: *12*	*Wetland Restoration Area, Cut to 111' AMSL*
10/24/2018	

Photograph: *13*	*Backfill of Wetland with Clean Structural Fill*
10/30/2018	

Photograph: *14*	*Transition Shelf Along AOC 3B Swale*
11/8/2018	

Photograph: *15*	*Backfilled Wetland and Cap Transition Shelf*
11/15/2019	

Photograph: *16*	*Protective Boot for National Grid Pole*
11/21/2018	

Photograph: *17*	*Straw and Tackifier Application for Winterization*
12/7/2018	

Photograph: *18*	*Coir Log Barrier for Winterization*
12/6/2018	

Photograph: 19	*Geosynthetics Stored for Winter*
12/14/2018	

Photograph: *20*	*Spring Remobilization*
4/5/2019	

Photograph: *21*	*Geomembrane Application: AOC 3B*
4/11/2019	

Photograph: *22*	*Wetland Channel Layout*
4/12/2019	

Photograph: *23*	*Geocomposite: AOC 3B*
4/22/2019	

Photograph: *24*	*Cover Soil Application: AOC 3B*
4/23/2019	

Photograph: *25*	*Stone Cap Transition: AOC 3A*
5/1/2019	

Photograph: *26*	*Top Soil Application: AOC 3B*
4/29/2019	

Photograph: *27*	*Wetland Hummocks*
5/8/2019	

Photograph: *28*	*Wetland Hydroseeding*
5/13/2019	

Photograph: *29*	*Cap Topsoil Hydroseeding*
5/15/2019	

Photograph: *30*	*Security Fence Installation*
5/29/2019	

Photograph: *31*	*Wetland Planting*
6/10/2019	

Photograph: *32*	*Super Sand Sack Removal*
6/18/2019	

Photograph: *33*	*Wetland Hummock Construction*
6/18/2019	

Photograph: *34*	*Planting Wetland Hummocks*
6/21/2019	

Appendix C
Landfill Design Modification
(Sheet Pile)

Memorandum

Environmental Resources Management

One Beacon Street, 5th Floor
Boston, MA 02108
+1 617 646 7800
+1 617 267 6440 (fax)

http://www.erm.com

To: Don McElroy, USEPA

Janet Waldron, MassDEP

From: ERM

Date: 26 November 2018

Subject: Iron Horse Park, Operable Unit 3, AOC 3
Remedial Action: Landfill Construction Field Revision

On behalf of Pan Am Railways (Pan Am), Environmental Resources Management (ERM) is submitting a field revision to the AOC 3 landfill design presented in the approved AOCs 1, 2, and 3 Final Design Report, and dated 24 September 2012. This revision is prompted from encountering refusal at a shallower depth while driving sheet pile in a localized segment in AOC 3A. Specifically, this modification is requested for AOC 3A for the following:

1. An adjustment to the final height of the steel sheet pile from sta 0+95 to sta 1+55 (height changed from 119 to 117)
2. An adjustment to the final height of the steel sheet pile because of encountered obstructions during installation between sta 2+27 and sta 2+40. The cap system will daylight to stone in this area (not be mechanically connected to the wall); and
3. Minor adjustment to the limits of cap and the cap transition to the wall.

STEEL SHEET PILE MODIFICATION

Station 0+95 to 1+55

An adjustment of the height of the sheet pile in this area is necessary to accommodate field conditions. The final height of the sheet pile would be adjusted from elevation 119 to elevation 117. Updated calculations for this revision were unnecessary as the stick up (cantilever) was reduced.

Station 2+22 to 2+40

A field revision is proposed to adjust the steel sheet pile embedment depth, cantilever height, and cap fill against the wall. This is necessary as

refusal was encountered along the last 18 linear feet of pile, i.e., from stations 2+22 to 2+40. Refusal was likely due to encountering underground obstructions believed to be boulders and/or rock obstructions.

Updated calculations for cantilever height were completed using the same software as utilized for the initial design; United States Army Corps of Engineers (USACE) *computer program for design and analysis of sheet pile walls by classical methods (CWALSHT)*. The updated input values (embedment depths and the stream elevation) were based off field measurements. The critical section is defined by the least embedment depth which occurred near station 2+32 to 2+37 (6.34 feet of embedment). This yielded an acceptable stick-up height for a final sheet pile top-of-wall elevation of 113.5. As such, the updated design does not allow fill to be placed above elevation 113.5 (along the entire length of Station 2+22 to 2+40 to be conservative). The wall height itself will be reduced to a top elevation of 114 (six inches of free board will remain to account for stream fluctuations). The updated design, which accommodate these new calculations, is reflected in Drawing A. The results of the calculations and associated back up are provided in Attachment A.

Pipe daylight

The design will retain the function of providing relief of percolation water through the underdrain system; there is no actual design change to this underdrain system. The sheet pile wall bottom drainage pipe will be day lighted to the newly proposed stone toe area in the northeastern corner of AOC 3A to outfall the percolation water (see Drawing A). Stone will be placed between the cap system daylight and the wall to enable the free drainage of the underdrain system.

LANDFILL COVER SYSTEM LIMIT MODIFICATION

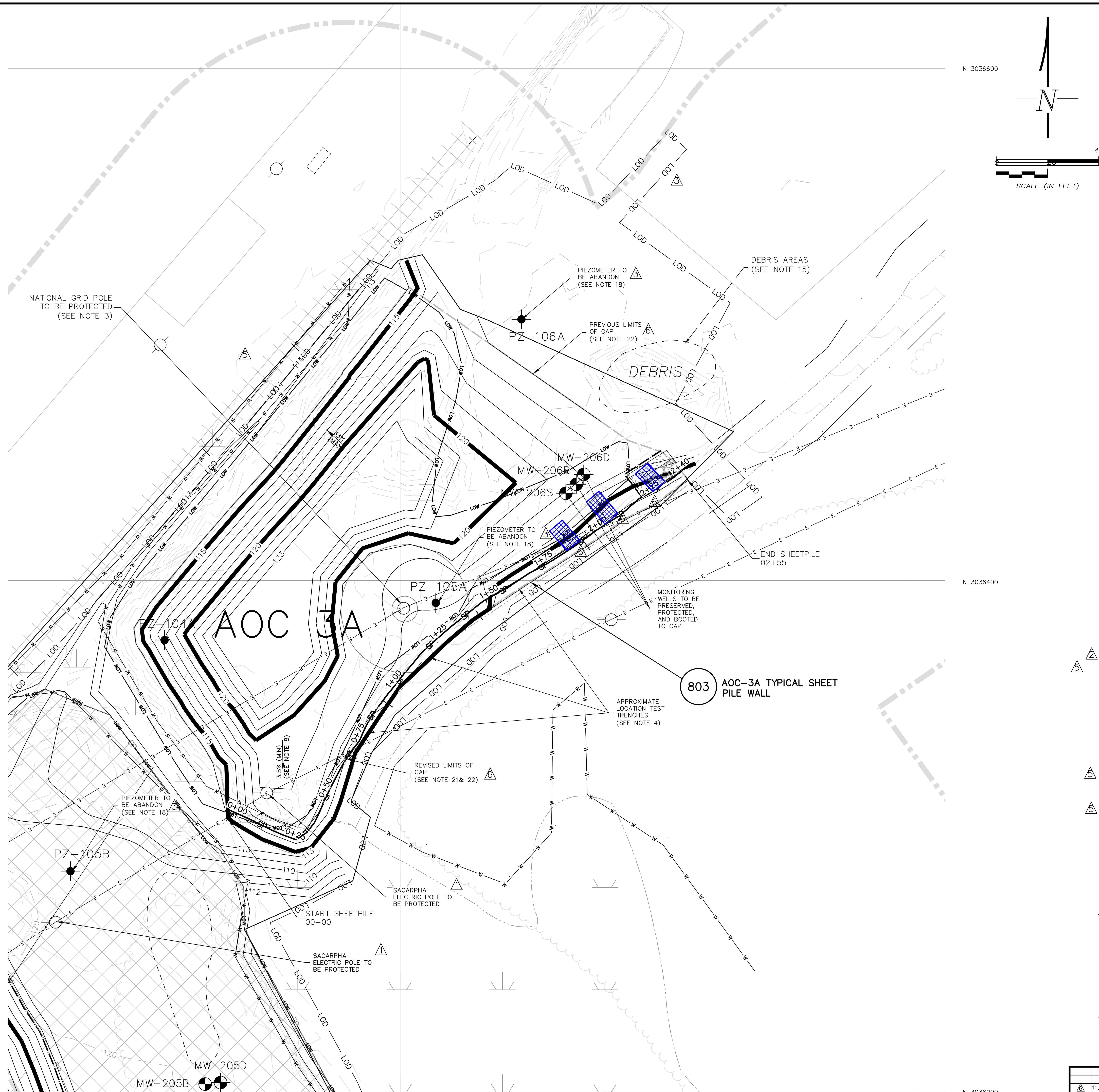
In order to accommodate the pipe daylighting, the cap limits have been nominally adjusted such that the limits of cap are approximately 10 feet back from the sheet pile wall (from stations 2+22 to 2+40). This is possible as the test pits excavated on 15 November 2018 did not identify waste in this area (see Attachment B for photo log). Consequently, the limits of waste were observed at approximately 15 feet from the location of the wall shown in Drawing 05A, thereby, allowing the limits of cap to be revised. Therefore all waste identified in this area will be covered by the cap. The approximate locations of the test pits are shown in Drawing 05A.

The cap will terminate in this area in accordance with detail A01 and A02 from design drawing A. The area between the cap termination and the steel sheet pile wall will be stone covered to promote drainage and minimize erosion.

In addition to the area of refusal, the sheet pile wall was slightly adjusted inward along the entire stream bank. This was necessary to allow the sheet pile to be installed at the toe of the existing slope (instead of within the stream itself). However, the limits of cap remains outside of the limits of waste (*e.g.*, all waste identified in this area is still covered by the cap).

SUMMARY

ERM is confident that the steel sheet pile wall and capping limit modifications are consistent with the intent of the design and manage the encountered obstructions. ERM is ready and willing to respond to any questions or concerns that the USEPA and/or MassDEP may have with the proposed field revision.



LEGEND

- MONITORING WELL LOCATION
- PIEZOMETER LOCATION
- SACARPHA TRANSMISSION POLE (WOODEN)
- 110 — EXISTING INDEX CONTOUR (5' INTERVAL)
- EXISTING INTERMEDIATE CONTOUR (1' INTERVAL)
- PROPOSED SUBBASE INDEX CONTOUR
- 122 — PROPOSED SUBBASE INTERMEDIATE CONTOUR
- LOD — LIMIT OF DISTURBANCE
- IRON HORSE PARK SITE BOUNDARY (AND PROPERTY BOUNDARY)
- LOW — APPROXIMATE LIMIT OF WASTE
- LIMIT OF CAP
- WASTE REMOVAL AREA
- WETLAND
- OPEN WATER/STREAMS/PONDS
- W — BORDERING VEGETATED WETLAND
- NON-JURISDICTIONAL STREAM
- MEAN ANNUAL HIGH WATER
- TREE LINE
- EXISTING FENCE
- SP — SHEET PILE
- E — POWER TRANSMISSION LINE
- NATIONAL GRID TRANSMISSION POLE
- RAILROAD TRACK
- (6) APPROXIMATE LOCATION OF TEST PITS (15 NOVEMBER 2018)

NOTES:

1. SEE DRAWING NO. 01 FOR GENERAL NOTES, ABBREVIATIONS AND LEGEND.
2. SEE DRAWING NO. 04 FOR AOC 3 SEQUENCE OF CONSTRUCTION.
3. EXISTING STRUCTURES INCLUDING RAILROAD TRACKS, NATIONAL GRID POLES, SACARPHA ELECTRIC POLES SHALL BE PROTECTED FROM DAMAGE. NO EXCAVATIONS SHALL OCCUR WITHIN A 25-FOOT RADIUS FEET OF THE NATIONAL GRID POLE.
4. PRIOR TO ANY LAND DISTURBANCE WITHIN AOC 3A, THE CONTRACTOR SHALL PERFORM THREE (3) TEST TRENCHES TEN (10) FEET IN LENGTH PERPENDICULAR WITH THE BANK IN LOCATIONS APPROVED BY THE ENGINEER TO DETERMINE IF WASTE IS PRESENT WITHIN THE BANK OF STREAM A. THE TRENCHES SHALL BE EQUALLY SPACED ALONG THE BANK, EXTENDING FROM MID-SLOPE TO THE SLOPE CREST, AND EXCAVATED TO AN ELEVATION OF 113 AMSL.

   CONSERVATIVELY, WASTE WAS ASSUMED TO BE LOCATED WITHIN THE BANK, REQUIRING THE SHEET WALL SUPPORT SYSTEM. IN THE EVENT THE TEST TRENCHES CONCLUDE THAT NO WASTE IS LOCATED BEYOND THE BANK SLOPE CREST, THE LIMIT OF THE CAP MAY BE REVISED ACCORDINGLY WITH AN ANTICIPATED REDUCTION (OR OMISSION) IN THE LENGTH OF THE SHEET PILE WALL.
5. WASTE SHALL BE EXCAVATED TO THE EXTENT OBSERVED OUTSIDE THE LIMIT OF CAP, INCLUDING OF THE AREA WITHIN THE LIMIT OF WASTE. THE VERTICAL AND LATERAL LIMITS OF EXCAVATION WITHIN THE WETLANDS WILL BE VISUALLY DETERMINED IN THE FIELD BY THE ENGINEER TO CONFIRM THAT WASTE IS NO LONGER PRESENT WITHIN THE AREA OF EXCAVATION. THE VERTICAL LIMIT OF EXCAVATION IS ESTIMATED AT AN ELEVATION OF 113 AMSL. EXCAVATED MATERIALS SHALL BE USED WITHIN AOC 3B TO MEET THE PRESENTED SUBBASE GRADES. MATERIALS SHALL PASS THE PAINT FILTER TEST PRIOR TO FINAL PLACEMENT OVER AOC 3B. EXCAVATION AREAS SHALL BE BACKFILLED WITH STRUCTURAL FILL AND/OR ORGANIC SOIL AS PRESENTED ON DRAWING NO. 7 FOR WETLAND RESTORATION/CREATION.
6. (1) EXCAVATION WITHIN AND ADJACENT TO THE WETLANDS IS TO OCCUR THROUGH THE WATER COLUMN (WET EXCAVATION). IF THE CONTRACTOR PREFERS TO DEWATER ANY PORTION OF THE EXCAVATION, ALL WATER REMOVED SHALL BE MANAGED AND DISCHARGED IN ACCORDANCE WITH NPDES REQUIREMENTS FOR ON-SITE DISCHARGE OR SHALL BE DISPOSED OFF-SITE AT AN APPROVED FACILITY. A COMPLETE DISCUSSION OF ANY PLANNED DEWATERING SHALL BE INCLUDED IN THE REQUIRED PROJECT WORK PLAN (PWP).
7. (1) WHERE THE EXISTING SIDE SLOPES WITHIN AOC 3A AND AOC 3B EXCEED 3:1, THE WASTE AND BANK SHALL BE EXCAVATED AND REGRADED OVER THE AOC. THE TOE OF THE SLOPE SHALL BE RELOCATED 10 FEET INWARD FROM FINAL CAPPED SLOPE TO ALLOW FOR THE CAP TRANSITION AND LAID BACK AT A 3:1 SLOPE, AS SHOWN. WASTE IS NOT ANTICIPATED BELOW THE BASE ELEVATION WITHIN THE 10-FOOT SET-BACK; HOWEVER, WASTE SHALL BE EXCAVATED TO DEPTH IF ALLOWED AND RE-GRADED OVER THE AOC, AT THE DIRECTION OF THE ENGINEER. THE 10-FOOT SET-BACK SHALL TERMINATE AT THE SHEET PILE WALL.
8. (5) (2) (1) THE GRADING OF AOC 3A AND 3B IS DESIGNED TO ACCOMMODATE THE CONSOLIDATION OF ON-SITE CUT AMOUNTS WITH MINIMUM IMPORTED FILL. THE REQUIRED VOLUME TO MEET THE SUBBASE GRADES FOR AOC 3A AND 3B ARE APPROXIMATELY 700 AND 8,600 CY, RESPECTIVELY. IF THE ACTUAL VOLUME OF MATERIALS REQUIRING CONSOLIDATION IS LESS THAN OR GREATER THAN ANTICIPATED, THE ELEVATION OF THE SUBBASE GRADE MAY BE MODIFIED AS APPROVED BY THE ENGINEER. THE MINIMUM SLOPE ALLOWED IS 3.5 PERCENT AND THE MAXIMUM ALLOWABLE GRADE IS 3:1, UNLESS OTHERWISE SPECIFICALLY NOTED (I.E. >20% SLOPE IN SECTION AREA OF AOC 3B).
9. FOR THE TRENCH EXCAVATION, THE CONTRACTOR SHALL PERFORM EXCAVATION OF SOIL AND/OR WASTE DOWN TO 6 FEET OR UNTIL WASTE IS NO LONGER OBSERVED AT THE EXCAVATION BOTTOM, AS DETERMINED BY THE ENGINEER, WHICHEVER IS DEEPER. EXCAVATED SOIL AND/OR WASTE SHALL BE CONSOLIDATED WITHIN AOC 3B. EXCAVATION SHALL BE BACKFILLED WITH STRUCTURAL FILL.
10. (1) WORK WILL BE PERFORMED IN ACCORDANCE WITH THE PROJECT WORK PLAN (PWP) PREPARED BY THE CONTRACTOR AND APPROVED BY THE ENGINEER.
11. CONTRACTOR SHALL CONTROL ODOR AS DIRECTED BY THE ENGINEER,
12. CONTRACTOR SHALL KEEP MATERIALS MOIST DURING EXCAVATION TO PREVENT DUST.
13. (5) (1) THE TOTAL ANTICIPATED QUANTITY OF CUT TO BE CONSOLIDATED WITHIN AOC 3A AND 3B ARE AS FOLLOWS:
    - AOC 3A: 750 CY FROM THE CUT SLOPES
    - AOC 3B: 3,700 CY FROM THE CUT SLOPES
    - WETLAND: 9,300 CY FROM THE WASTE REMOVAL AREAS
14. (5) (1) THE APPROXIMATE FILL REQUIREMENTS FOR THE LANDFILLS AND SURROUNDING AREAS ARE AS FOLLOWS:
    - ON-SITE CUT: 13,700 CY
    - OFF-SITE STRUCTURAL FILL: 0 CY

    THE CONTRACTOR MAY REDUCE THE GRADES UNIFORMLY, BUT TO NO LESS THAN THE MINIMUM 3.5 PERCENT, TO BALANCE THE CUT AND FILL.
15. THE DEBRIS MATERIALS SHALL BE SEPARATED AND RECYCLED TO THE MAXIMUM EXTENT PRACTICABLE TO OWNER APPROVED RECYCLING FACILITY. NON-RECYCABLE BULK ITEMS SHALL BE PROPERLY DISPOSED OFF-SITE TO OWNER APPROVED DISPOSAL FACILITY. REMAINING MATERIALS (I.E. CONCRETE) SHALL BE USED FOR THE PURPOSE OF THE SUBBASE FILL MATERIAL. THE CONTENT OF THE DEBRIS AREAS IS ESTIMATED TO BE PREDOMINATELY FILL MATERIAL. RECYCLABLE MATERIALS ARE ANTICIPATED TO INCLUDE METALS, EMPTY 55-GALLON DRUMS, TIRES, RAILROAD TIES AND PLASTICS. BULK MATERIALS ARE ANTICIPATED TO INCLUDE HOUSEHOLD GOODS. FILL MATERIALS CONSIST OF CONCRETE TO BE CRUSHED.
16. (1) THE SUBBASE SHALL NOT CONTAIN ANY STONES OR DEBRIS IN THE UPPER THREE INCHES TO ENSURE AN ADEQUATE SURFACE FOR THE OVERLAYING GEOMEMBRANE; OTHERWISE A GEOTEXTILE SHALL BE PLACED TO PROTECT THE GEOMEMBRANE.
17. (1) THE REQUIRED THICKNESS OF THE ENGINEERED CAP SHALL BE CONSTRUCTED TO THE LIMITS OF CAP OR LIMITS OF WASTE WHEN NO ADJACENT LIMITS OF CAP IS SHOWN. THE ENGINEERING CAP SHALL TRANSITION BEYOND THE RESPECTED LINE TO THE EXISTING GRADE.
18. (3) ALL PIEZOMETERS WITHIN THE LIMITS OF DISTURBANCE SHALL BE ABANDON IN PLACE. CONTRACTOR SHALL FILL THE PIEZOMETERS WITH BENTONITE CHIPS AND THE PVC CASING SHALL BE CUT FLUSH TO THE SURFACE. CONTRACTOR SHALL PERFORM THIS WORK WITH DIRECT OVERSIGHT OF THE ENGINEER. ALL WELLS WITH THE LIMITS OF DISTURBANCE SHALL BE BE PRESERVED AND PROTECTED THROUGHOUT CONSTRUCTION. CONTRACTOR IS ALSO REQUIRED TO BOOT ALL WELLS WITH THE LIMITS OF CAP TO THE GEOMEMBRANE CAP AS SHOWN ON DETAIL 1104.
19. (5) EXISTING TOPOGRAPHY AND SOUTHERN EDGE OF THE RAIL ROAD TRACKS WERE REVISED USING THE PRE-CONSTRUCTION SURVEY DATED SEPTEMBER 2018 PERFORMED BY CHARTER.
20. (5) THE SLOPES ALONG THE ACESS ROAD SHALL BE 8% TYPICAL.
21. (6) THE LIMITS OF CAP WAS ADJUSTED FROM STA 0+00 TO 2+22 BASED ON THE LOCATION OF THE INSTALLED SHEET PILE WALL. HOWEVER, THE LIMITS OF WASTE IS STILL WITHIN THE REVISED LIMITS OF CAP. THE SHEET PILE WALL WAS INSTALLED AT THE TOE OF THE EXISTING SLOPE AT ELEVATION 113 FT AMSL, I.E. AT THE EDGE OF THE STREAM. THE ORIGINAL DESIGN HAD THE SHEET PILE WALL (I.E. LIMITS OF CAP) WITHIN THE STREAM WHICH WOULD REDUCE THE STREAM'S CROSS SECTION.
22. (6) FROM STA. 0+00 TO 2+22 THE SHEET PILE AND LIMIT AND CAP ALIGNMENT ARE THE SAME.

Rev.	Date	Description	By	Chk
6	11/15/2018	UPDATE FOR SHEET PILE REFUSAL	MP	DQ
5	10/11/2018	UPDATED EXISTING CONTOURS PER PRE-CONSTRUCTION SURVEY	MP	DQ
4	8/13/2018	AOC 3 CONSTRUCTION DRAWINGS	MP	DQ
3	7/27/2018	AOC 3 CONSTRUCTION DRAWINGS	MP	DQ
2	7/17/2018	AOC 3 CONSTRUCTION DRAWINGS	MP	DQ
1	7/13/2018	AOC 3 DRAFT CONSTRUCTION DRAWINGS	MP	DQ

DRAWN BY AK | CADD Review MP | CHECKED BY DQ

ERM

Environmental Resources Management

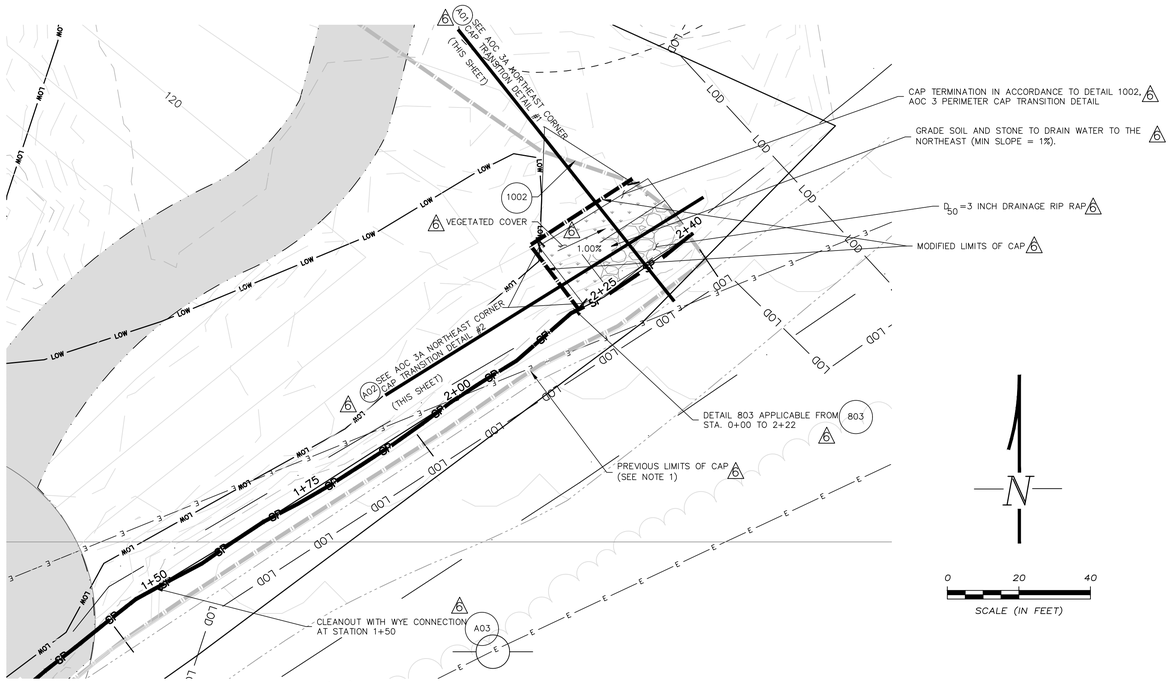
PAN AM RAILWAYS
IRON HORSE PARK

BILLERICA, MASSACHUSETTS

AOC 3A SUBBASE GRADING PLAN

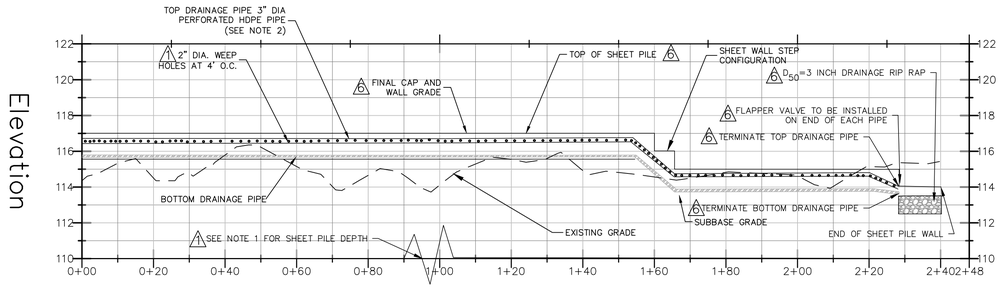
SCALE	PROJECT NUMBER	DRAWING	REV.
AS NOTED	0433434	05A (1)	6

DATE DRAWN 9/12/2012



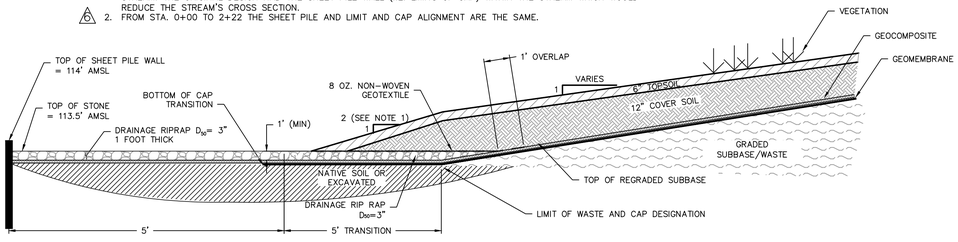
AOC 3A DESIGN CHANGE

NOTE:
1. THE LIMITS OF CAP WAS ADJUSTED FROM STA 0+00 TO 2+22 BASED ON THE LOCATION OF THE INSTALLED SHEET PILE WALL. HOWEVER, THE LIMITS OF WASTE IS STILL WITHIN THE REVISED LIMITS OF CAP. THE SHEET PILE WALL WAS INSTALLED AT THE TOE OF THE EXISTING SLOPE AT ELEVATION 113 FT AMSL, I.E. AT THE EDGE OF THE STREAM. THE ORIGINAL DESIGN HAD THE SHEET PILE WALL (I.E. LIMITS OF CAP) WITHIN THE STREAM WHICH WOULD REDUCE THE STREAM'S CROSS SECTION.
2. FROM STA. 0+00 TO 2+22 THE SHEET PILE AND LIMIT AND CAP ALIGNMENT ARE THE SAME.



AOC 3A SHEET PILE WALL PROFILE

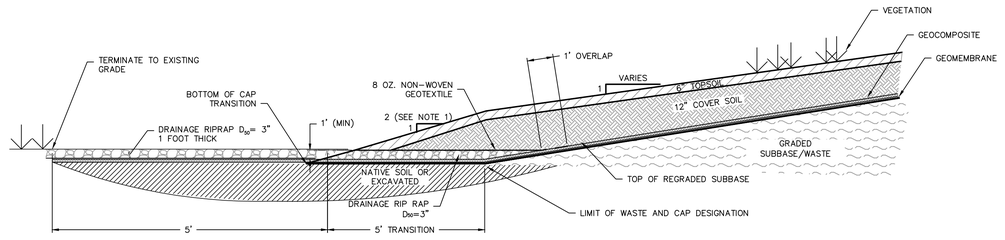
NOTE:
1. THE 3" DIA DRAINAGE PIPE SHALL INSTALLED AS LOW AS POSSIBLE ABOVE THE GEOMEMBRANE BUT SHALL NOT BE INSTALLED BELOW THE ELEVATION OF 113.75 ASML.
2. THE WEEP HOLES SHALL BE LOCATED IN THE CENTER ⅓ OF THE SHEET PILE WEB, NOT THROUGH THE INTERLOCK. THE CONTRACTOR MAY NEED TO FIELD ADJUST THE LOCATION OF THE WEEP HOLES, ACCORDINGLY, WITH PRIOR APPROVAL FROM ENGINEER.
3. THE CONTACTOR SHALL INSTALL THE WEEP HOLES HYDRAULICALLY THROUGH THE SHEET PILE. ALTERNATIVE METHODS SHALL BE SUBMITTED AND APPROVED BY THE ENGINEER.



NOTE:
1. IN AREAS WHERE THE SUBBASE GRADE SIDE SLOPE IS 3:1 AT THE PERIMETER, THE TRANSITION SHALL REMAIN AT A 3:1 SLOPE THEREFORE, THERE IS A 5.5-FOOT LONG TRANSITION. IN AREAS FLATTER THAN 3:1 AT THE PERIMETER, THE TRANSITION SHALL BE 2:1.

A01/A AOC 3A NORTHEAST CORNER CAP TRANSITION DETAIL #1

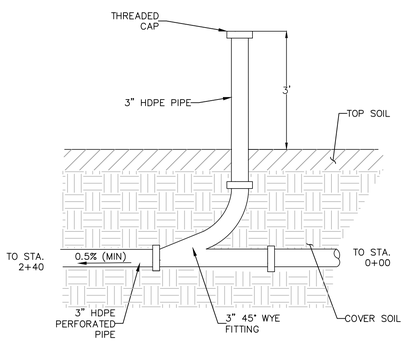
NOT TO SCALE



NOTE:
1. IN AREAS WHERE THE SUBBASE GRADE SIDE SLOPE IS 3:1 AT THE PERIMETER, THE TRANSITION SHALL REMAIN AT A 3:1 SLOPE THEREFORE, THERE IS A 5.5-FOOT LONG TRANSITION. IN AREAS FLATTER THAN 3:1 AT THE PERIMETER, THE TRANSITION SHALL BE 2:1.

A02/A AOC 3A NORTHEAST CORNER CAP TRANSITION DETAIL #2

NOT TO SCALE



A03/A TYPICAL SHEET PIPE WALL DRAIN PIPE CLEANOUT DETAIL

NOT TO SCALE

Rev.	Date	Description	By	Chk
7	11/15/2018	UPDATE FOR SHEET PILE REFUSAL	MP	DQ
6	10/11/2018	UPDATED EXISTING CONTOURS PER PRE-CONSTRUCTION SURVEY	MP	DQ
5	8/13/2018	AOC 3 CONSTRUCTION DRAWINGS	MP	DQ
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3	7/17/2018	AOC 3 CONSTRUCTION DRAWINGS	MP	DQ
2	7/13/2018	AOC 3 DRAFT CONSTRUCTION DRAWINGS	MP	DQ
1	7/13/2018	AOC 3 DRAFT CONSTRUCTION DRAWINGS	MP	DQ

DRAWN BY AK | CADD Review MP | CHECKED BY DQ

Environmental Resources Management

ERM

PAN AM RAILWAYS IRON HORSE PARK

BILLERICA, MASSACHUSETTS

AOC 3A DESIGN CHANGE: WALL VERTICAL ALIGNMENT MODIFICATIONS AND LIMIT OF CAP MODIFICATION

SCALE	PROJECT NUMBER	DRAWING	REV.
AS NOTED	0433434	A	6

DATE DRAWN 9/12/2012

G:\Tecom\DWG\ACAD\Drawings\Pan Am Railways\2018-11-15 Rev 6 Update for sheet pile refusal\0433434-05.dwg

Attachment A

PURPOSE:
Determine sheet pile length, steel grade, and section.

METHODOLOGY:
Use U.S. Army Corps of Engineers CWALSHT Program Output Data (Appendix C) for the Critical Section.

The following data was obtained from the CWALSHT Input/Output file (Appendix C).

Penetration Depth = 8.59 ft.
Maximum Bending Moment = 3.25×10^3 lb.*ft. = 3.25 kips*ft.
Maximum Scaled Defection = 2.82×10^8 lb.*in^3 at elevation = 115.00 ft. (top of sheet pile)

Calculate required length of sheet pile:

$$\textbf{Required Length} = \left(Penetration\ Depth\right) + Excavation\ Height$$

=8.59 ft. + 4.46 ft.
= 13.05 ft.

Calculate allowable design stress of steel pile:

For ASTM A328 Steel, (Ref. I)
Yield Strength = 60 ksi = 60,000 lb./in^2

$$\textbf{Allowable Design Stress} = 0.65\ x\ Minimum\ Yield\ Strength\ of\ Steel$$ (Ref. H)

= 0.65 x 60 ksi
= 39 ksi

$$\textbf{Factory of Safety} = \left(\frac{39}{25}\right) = 1.56$$

Calculate Maximum Deflection of Sheet Pile:

(Maximum deflection of cantilevered wall is at top of wall)

$$\textbf{Maximum Deflection} = \frac{Maximum\ Scaled\ Deflection}{\begin{pmatrix} Steel\ Modulus \\ of\ Elasticity \end{pmatrix}\begin{pmatrix} Pile\ Section \\ Moment\ of\ Inertia \end{pmatrix}}$$

where:

Maximum Scaled Deflection is an output from CWALSHT
Steel Modus of Elasticity = 30 x10^6 lb./in^2 (Ref. J)
For sheet pile section AZ 18 – 800 Moment of Inertia = 302.6 in^4 (per foot of wall); stocked by skyline steel (Ref. I)

$$\textbf{Maximum Deflection} = \frac{2.82x10^8\ \ [\ lb * in^3]}{\left(30x10^6\ \left[{}^{lb}/_{in^2}\right]\right)\left(\begin{matrix}302.6 \\ \left[{}^{in^4}/_{ft}\right]\end{matrix}\right)}$$

= 0.031 inches

$$\textbf{Allowable Design Deflection}\ (\textbf{in}) = (0.4)\big(Design\ Height\ (ft)\big)$$ (Ref. M)

where:

Design height of the sheet pile wall is measured from the dredge line or the design height is equal to the excavation depth closest to the sheet pile wall. The design height is equal to 4.46 ft.

$$\textbf{Allowable Design Deflection}\ (\textbf{in}) = 0.4\ (4.46\ ft)$$
= 1.8 inches

This is okay, since the maximum deflection calculated is less than the allowable design deflection, 0.031 < 1.8 inches, respectively.

Calculate Section Modulus Required: (Ref. K)

$$\textbf{Section Modulus Required} = \frac{(Maximum\ Bending\ Moment)\left(12\ {}^{in}/_{ft}\right)}{\begin{pmatrix} Allowable\ Design\ Stress \\ of\ Steel\ Grade \end{pmatrix}}$$

where:

Maximum bending moment is an output from CWALSHT

For regular carbon grade (ASTM A 572 Gr 60), allow design stress is 39,000 psi (Ref. H)

$$\textbf{\textit{Section Modulus Required}} = \frac{(3.25x10^3\ lb * ft)\left(12\ {}^{in}/_{ft}\right)}{\left(39{,}000\ {}^{lb}/_{in^2}\right)}$$

$$= 1.001\ in^3 \text{ (per foot of wall)}$$

Calculate Factor of Safety of Section Modulus of Selected Sheet Pile Section:

For sheet pile section AZ 18 – 700, the section modulus is 34.2 in^3 or 34.2, respectively (per foot of wall) (Ref. I)

$1.001\ in^3 < 34.2\ in^3 \longrightarrow$ Okay

$$\textbf{\textit{Factory of Safety}} = \left(\frac{34.2}{1.001}\right) = 34.16 \longrightarrow \text{Okay}$$

RESULTS:

Sheet Pile Length = 13.05 ft.
Sheet Pile Grade = ASTM A 572 Gr 60 (60 ksi)
Sheet Pile Section = AZ 18 – 700

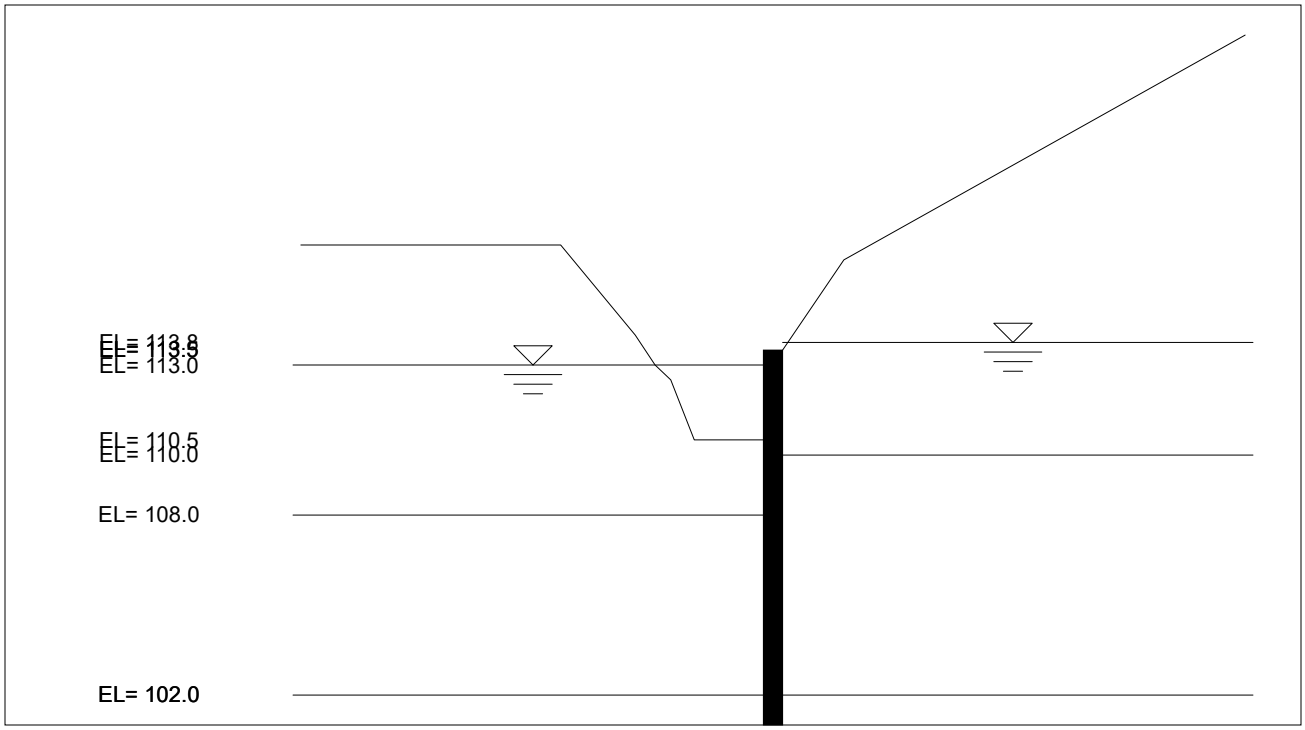
Sheet #	Station Location	Sheet Length (ft)	Top Elevation (ft)	Bottom Elevation (ft)	creek floor grade	actual embedment	acceptable stick up	top of wall - computed	top of wall - design
1	1+97 to 2+02	22.5	121.71	99.21	110.54	11.33	6.46	117.0	**115.5**
2	2+02 to 2+07	17.5	115.13	97.63	110.54	12.91	6.46	117.0	**115.5**
3	2+07 to 2+12	17.5	116.54	99.04	110.54	11.5	6.46	117.0	**115.5**
4	2+12 to 2+17	17.5	117.54	100.04	110.54	10.5	5.46	116.0	**115.5**
5	2+17 to 2+22	17.5	117.21	99.71	110.54	10.83	5.46	116	**115.5**
6	2+22 to 2+27	17.5	119.71	102.21	110.54	8.33	4.46	115	**115.0**
7	2+27 to 2+32	17.5	121.04	103.54	110.54	7	3.46	114	**114.0**
8	2+32 to 2+37	17.5	121.63	104.13	110.54	6.41	2.96	113.5	**113.5**
9	2+37 to 2+42	17.5	121.29	103.79	110.54	6.75	2.96	113.5	**113.5**
10	2+42 to 2+47	17.5	121.21	103.71	110.54	6.83	2.96	113.5	**113.5**

Critical Section in Calculation

creek elevation	110.54	110.54	110.54	110.54	110.54	110.54	110.54
	13.5	14	14.5	15	15.5	16	17
top of wall	113.5	114	114.5	115	115.5	116	117
bottom of wall (from model)	104.16	103.4	102.63	101.91	101.19	100.5	99.17
embedment depth	**6.34**	**7.1**	**7.87**	**8.59**	**9.31**	**10**	**11.33**
stick up	2.96	3.46	3.96	4.46	4.96	5.46	6.46
required length from model	9.3	10.56	11.83	13.05	14.27	15.46	17.79
required length from model (check)	9.34	10.6	11.87	13.09	14.31	15.5	17.83
Maximum Bending Moment		1.63E+03		3.25E+03			
Maximum Scaled Defection (lb-in^3)		9.07E+07		2.82E+08			
ASTM A 572 Gr. 60 steel yield strength (ksi)		60		60			
allowable design stress (ksi)		39		39			
factor of safety		1.56		1.56			
steel modulus of elasticity		3.00E+07		3.00E+07			
AZ - 18 pile moment of inertia		276.8		302.6			
AZ - 18 - 700 section modulus (in^3/ft)		33.5		33.5			
max deflection (inches)		0.011		0.031			
section modulus required (in^3)		0.503		1.001			

'IRON HORSE PARK

'MB TOP OF WALL AT ELEVATION 113.5



Metcalf & Eddy, Inc.
ENGINEERS

GEOLOGIC LOG

PROJECT : **Iron Horse Park Superfund Site - 3rd Operable Unit**		SHEET **1 OF 3**	BORING NO. **MW-206**
SITE LOCATION: **North Billerica, MA** **B&M Loco. Shop Disposal** **Area A**	JOB NO.: **4609-36-18-5**		
	LOCATION: **N: 575774.07 E: 662973.00**	Ground Elevation: **118.35**	Total Depth (feet) **55.0**
DRILL CONTRACTOR: **D.L. Maher**	ENG/GEO: **B. Buelow**	BEGUN : 2/2/95	
DRILL RIG: **Mobile B-53 ATV**	DRILLER: **J. Graglia**	FINISHED: 2/8/95	
Hole Size: **5-8"**	WEATHER: **Sunny (20's & 30's)**	Ground Water (Depth/Elev.): **5.5/112.9**	
DRILLING METHOD: **See Notes**	Drilling Fluid: **Town Water**	Top of Rock (Depth/Elev.): **25.0**	

Depth	SAMPLE TYPE/NO.	PID Value (ppm)	Blow Counts (per 6 in.) or Drilling Rate (min/ft)	Sample Recovery or REC and RQD	SAMPLE DESCRIPTION	Elev. (USGS Datum) 118.35	STRATIGRAPHIC DESCRIPTION
	SS 1	8.0	8-8 7-7	1.1	Black silty fine SAND, little medium to coarse sand, trace wood, ash		FILL: Black, silty fine SAND, little medium to coarse sand, trace wood, ash
	SS 2	8.0	10-7 7-8	1.8	Black, silty fine SAND; changes to orange-brown, silty fine to medium SAND	115-	
5	SS 3	0.0	5-6 14-17	2.0	Tan silty fine to coarse SAND, little fine gravel, wet ▽		
					Use Ø = 28	110-	
10	SS 4	0.0	5-5 5-7	1.0	Tan silty fine to coarse SAND, trace fine gravel		GLACIAL OUTWASH: Tan, silty fine to coarse SAND, little fine gravel
						105-	
15	SS 5	0.0	2-3 3-6	1.0	Tan silty, fine to coarse SAND, trace fine gravel		
						100-	
	SS 6	0.0	6-7 10-23	1.2	Tan silty fine to coarse SAND, trace fine gravel, trace clay		

SAMPLE TYPES:
SS=Standard Split Spoon, S3=3" Split Spoon
NX=2" Rock Core

NOTES: Overburden wells were drilled w/4.25" HSA. Bedrock well was drilled w/ 4" HW casing & 3 7/8" rollerbit. A downhole hammer was used for sampling.

Approved\Date

Table 3-1
Granular Soil Properties (after Teng 1962)

Compactness	Relative Density (%)	SPT N (blows per ft)	Angle of Internal Friction (deg)	Unit Weight	
				Moist (pcf)	Submerged (pcf)
Very Loose	0-15	0-4	<28	<100	<60
Loose	16-35	5-10	28-30	95-125	55-65
Medium	36-65	11-30	31-36	110-130	60-70
Dense	66-85	31-50	37-41	110-140	65-85
Very Dense	86-100	>51	>41	>130	>75

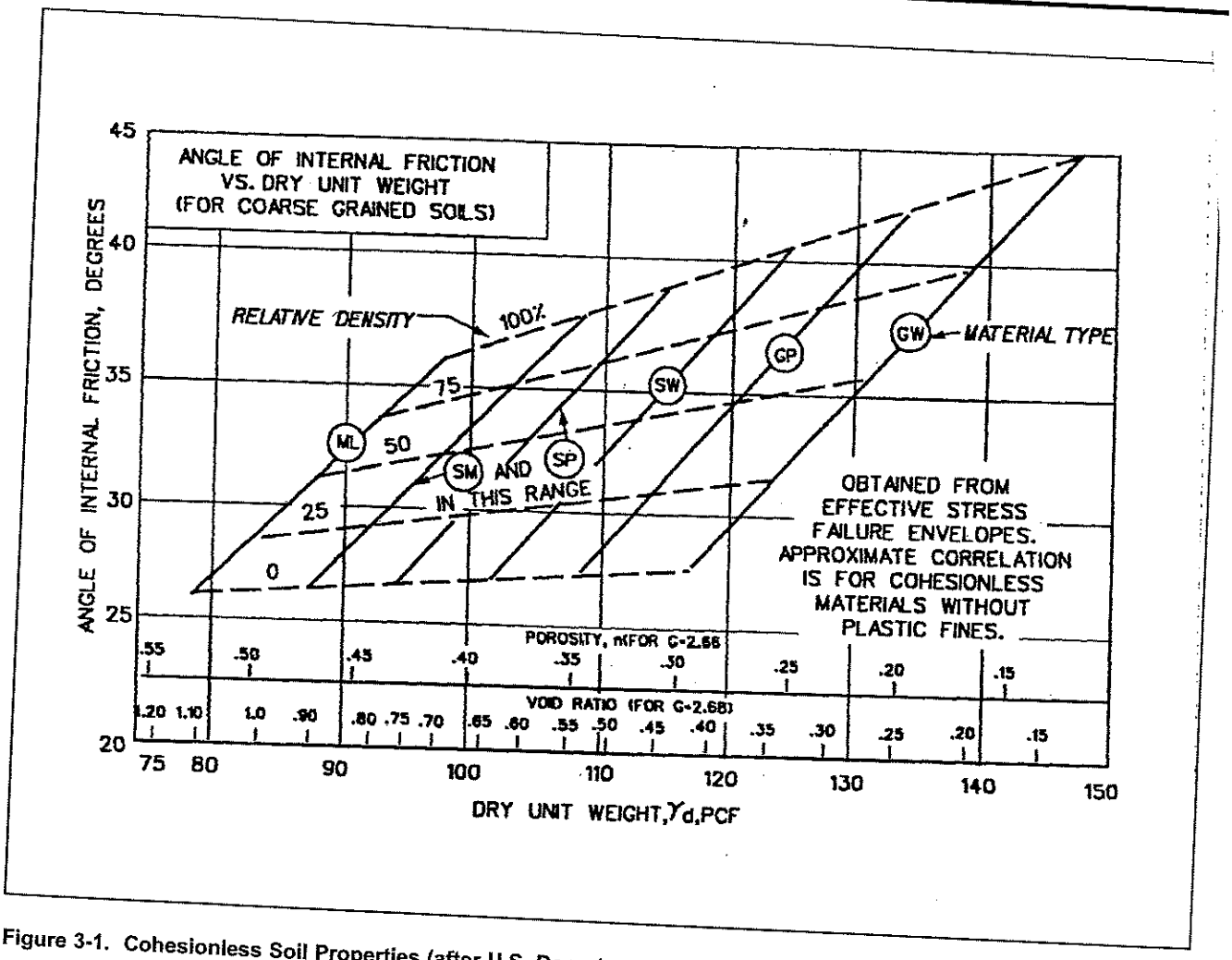
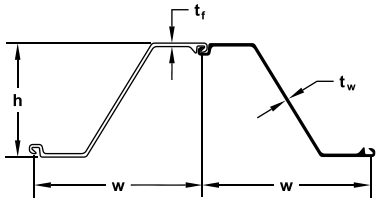


Figure 3-1. Cohesionless Soil Properties (after U.S. Department of the Navy 1971)

AZ

AZ Hot Rolled Steel Sheet Pile



SECTION	Width (w) in (mm)	Height (h) in (mm)	THICKNESS Flange (t_f) in (mm)	THICKNESS Web (t_w) in (mm)	Cross Sectional Area in²/ft (cm²/m)	WEIGHT Pile lb/ft (kg/m)	WEIGHT Wall lb/ft² (kg/m²)	SECTION MODULUS Elastic in³/ft (cm³/m)	SECTION MODULUS Plastic in³/ft (cm³/m)	Moment of Inertia in⁴/ft (cm⁴/m)	COATING AREA Both Sides ft²/ft of single (m²/m)	COATING AREA Wall Surface ft²/ft² (m²/m²)
AZ 12-770	30.31 770	13.52 344	0.335 8.5	0.335 8.5	5.67 120.1	48.78 72.6	19.31 94.3	23.2 1245	27.5 1480	156.9 21430	6.07 1.85	1.20 1.20
AZ 13-770	30.31 770	13.54 344	0.354 9.0	0.354 9.0	5.94 125.8	51.14 76.1	20.24 98.8	24.2 1300	28.8 1546	163.7 22360	6.07 1.85	1.20 1.20
◆ AZ 14-770	30.31 770	13.56 345	0.375 9.5	0.375 9.5	6.21 131.5	53.42 79.5	21.14 103.2	25.2 1355	30.0 1611	170.6 23300	6.07 1.85	1.20 1.20
AZ 17-700	27.56 700	16.52 420	0.335 8.5	0.335 8.5	6.28 133.0	49.12 73.1	21.38 104.4	32.2 1730	37.7 2027	265.3 36230	6.10 1.86	1.33 1.33
AZ 18-700	27.56 700	16.54 420	0.354 9.0	0.354 9.0	6.58 139.2	51.41 76.5	22.39 109.3	33.5 1800	39.4 2116	276.8 37800	6.10 1.86	1.33
◆ AZ 19-700	27.56 700	16.56 421	0.375 9.5	0.375 9.5	6.88 145.6	53.76 80.0	23.35 114.3	34.8 1870	41.0 2206	288.4 39380	6.10 1.86	1.33
AZ 20-700	27.56 700	16.57 421	0.394 10.0	0.394 10.0	7.18 152.0	56.11 83.5	24.43 119.3	36.2 1945	42.7 2296	300.0 40960	6.10 1.86	1.33 1.33
AZ 18-800	31.5 800	17.68 449	0.335 8.5	0.335 8.5	6.07 128.6	54.26 80.7	20.67 100.9	34.2 1840	39.7 2135	302.6 41320	6.82 2.08	1.30 1.30
AZ 20-800	31.5 800	17.72 450	0.375 9.5	0.375 9.5	6.66 141.0	59.50 88.6	22.67 110.7	37.2 2000	43.3 2330	329.9 45050	6.82 2.08	1.30 1.30
AZ 22-800	31.5 800	17.76 451	0.413 10.5	0.413 10.5	7.25 153.5	64.77 96.4	24.68 120.5	40.3 2165	47.0 2525	357.3 48790	6.82 2.08	1.30 1.30
AZ 23-800	31.50 800	18.66 474	0.453 11.5	0.354 9.0	7.12 150.6	63.56 94.6	24.22 118.2	43.3 2330	49.9 2680	404.6 55260	6.94 2.11	1.32 1.32
AZ 25-800	31.50 800	18.70 475	0.492 12.5	0.394 10.0	7.71 163.3	68.91 102.6	26.26 128.2	46.5 2500	53.8 2890	435.1 59410	6.94 2.11	1.32 1.32
AZ 27-800	31.50 800	18.74 476	0.531 13.5	0.433 11.0	8.31 176.0	74.26 110.5	28.29 138.1	49.7 2670	57.6 3100	465.5 63570	6.94 2.11	1.32 1.32
AZ 24-700	27.56 700	18.07 459	0.441 11.2	0.441 11.2	8.23 174.1	64.30 95.7	28.00 136.7	45.2 2430	53.5 2867	408.8 55820	6.33 1.93	1.38 1.38
◆ AZ 26-700	27.56 700	18.11 460	0.480 12.2	0.480 12.2	8.84 187.2	69.12 102.9	30.10 146.9	48.4 2600	57.1 3070	437.3 59720	6.33 1.93	1.38 1.38
AZ 28-700	27.56 700	18.15 461	0.520 13.2	0.520 13.2	9.46 200.2	73.93 110.0	32.19 157.2	51.3 2760	60.9 3273	465.9 63620	6.33 1.93	1.38 1.38
AZ 28-750	29.53 750.0	20.04 509.0	0.472 12.00	0.394 10.00	8.09 171.2	67.73 100.80	27.53 134.40	52.3 2810	60.3 3245	523.9 71540	6.93 2.11	1.41 1.41
AZ 30-750	29.53 750.0	20.08 510.0	0.512 13.00	0.433 11.00	8.73 184.7	73.08 108.80	29.70 145.00	55.9 3005	64.8 3485	561.5 76670	6.93 2.11	1.41 1.41
AZ 32-750	29.53 750.0	20.12 511.0	0.551 14.00	0.472 12.00	9.37 198.3	78.44 116.70	31.88 155.60	59.5 3200	69.2 3720	599.0 81800	6.93 2.11	1.41 1.41
AZ 36-700N	27.56 700	19.65 499	0.591 15.0	0.441 11.2	10.20 215.9	79.72 118.6	34.71 169.5	66.8 3590	76.4 4110	656.2 89610	6.73 2.05	1.47 1.47
◆ AZ 38-700N	27.56 700	19.69 500	0.630 16.0	0.480 12.2	10.87 230.0	84.94 126.4	36.98 180.6	70.6 3795	81.1 4360	694.5 94840	6.73 2.05	1.47 1.47
AZ 40-700N	27.56 700	19.72 501	0.669 17.0	0.520 13.2	11.54 244.2	90.16 134.2	39.26 191.7	74.3 3995	85.7 4605	732.9 100080	6.73 2.05	1.47 1.47
AZ 42-700N	27.56 700	19.65 499	0.709 18.0	0.551 14.0	12.22 258.7	95.51 142.1	41.59 203.1	78.2 4205	90.3 4855	768.4 104930	6.75 2.06	1.47 1.47
AZ 44-700N	27.56 700	19.69 500	0.748 19.0	0.591 15.0	12.89 272.8	100.74 149.9	43.87 214.2	81.9 4405	95.0 5105	806.6 110150	6.75 2.06	1.47 1.47
AZ 46-700N	27.56 700	19.72 501	0.787 20.0	0.630 16.0	13.56 287.0	105.97 157.7	46.14 225.3	85.7 4605	99.5 5350	844.9 115370	6.75 2.06	1.47 1.47
AZ 46	22.83 580	18.94 481	0.709 18.0	0.551 14.0	13.76 291.2	89.10 132.6	46.82 228.6	85.5 4595	98.5 5295	808.8 110450	6.20 1.89	1.63 1.63
AZ 48	22.83 580	18.98 482	0.748 19.0	0.591 15.0	14.48 306.5	93.81 139.6	49.28 240.6	89.3 4800	103.3 5553	847.0 115670	6.20 1.89	1.63 1.63
AZ 50	22.83 580	19.02 483	0.787 20.0	0.630 16.0	15.22 322.2	98.58 146.7	51.80 252.9	93.3 5015	108.2 5816	886.5 121060	6.20 1.89	1.63 1.63
AZ 48-700	27.56 700.0	19.80 503.0	0.866 22.00	0.591 15.00	13.63 288.4	106.49 158.50	46.37 226.40	88.4 4755	102.1 5490	876.2 119650	6.70 2.04	1.46 1.46
AZ 50-700	27.56 700.0	19.84 504.0	0.906 23.00	0.630 16.00	14.30 302.6	111.73 166.30	48.65 237.50	92.2 4955	106.7 5735	914.6 124890	6.70 2.04	1.46 1.46
AZ 52-700	27.56 700.0	19.88 505.0	0.945 24.00	0.669 17.00	14.97 317.0	116.97 174.10	50.93 248.70	95.9 5155	111.3 5985	953.0 130140	6.70 2.04	1.46 1.46

Installed on site

◆ In stock.

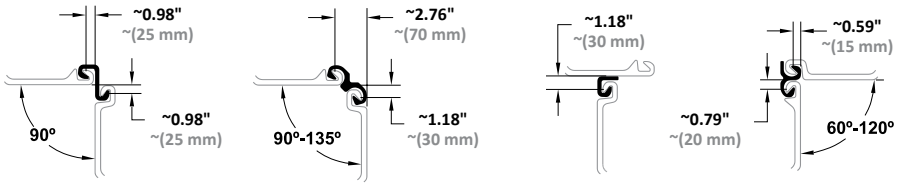
AZ

AZ Hot Rolled Steel Sheet Pile

Available Steel Grades										
AMERICAN			CANADIAN			EUROPEAN			AMLoCor®**		
ASTM	YIELD STRENGTH		CSA G40.21	YIELD STRENGTH		EN 10248	YIELD STRENGTH			YIELD STRENGTH	
	(ksi)	(MPa)		(ksi)	(MPa)		(ksi)	(MPa)		(ksi)	(MPa)
A 328	39	270	Grade 260 W	38	260	S 240 GP	35	240	Blue 320	46	320
A 572 Gr. 42	42	290	Grade 300 W	43	300	S 270 GP	39	270	Blue 355	51	355
A 572 Gr. 50	50	345	Grade 350 W	51	355	S 320 GP	46	320	Blue 390	57	390
A 572 Gr. 55	55	380	Grade 400 W	58	400	S 355 GP	51	355			
A 572 Gr. 60	60	415				S 390 GP	57	390			
A 572 Gr. 65	65	450				S 430 GP	62	430			
A 690	50	345				S 460 AP	67	460			
A 690*	57	390									

Highlighted fields represent the most commonly used and readily available steel grades. *Not available for AZ48/50/52-700. ** Corrosion resistant steel, check for availability

Corner Piles



C 14
Grade: S 355 GP
Weight: 9.68 lb/ft
(14.4 kg/m)

Omega 18
Grade: S 430 GP
Weight: 12.10 lb/ft
(18.0 kg/m)

E 22
Grade: S 355 GP
Weight: 6.87 lb/ft
(10.2 kg/m)

Delta 13
Grade: S 355 GP
Weight: 8.73 lb/ft
(13.0 kg/m)

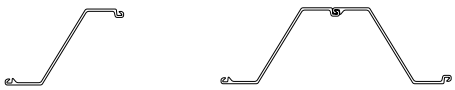
Delivery Conditions & Tolerances

	ASTM A 6		EN 10248	
Mass	± 2.5%		± 5%	
Length	+ 5 inches	– 0 inches	± 200 mm	
Height			± 7 mm	
Thickness			≤ 8.5 mm	± 0.5 mm
			> 8.5 mm	± 6%
Width			± 2%	
Double Pile Width			± 3%	
Straightness			0.2% of the length	
Ends out of Square			2% of the width	

Delivery Forms

Single Pile
Position A

Double Pile
Form I Standard



Single Pile
Position B

Double Pile
Form II on Request

Maximum Rolled Lengths*

AZ	101.7 feet	(31.0 m)
E 22	59.1 feet	(18.0 m)
C 14	59.1 feet	(18.0 m)
Delta 13	55.8 feet	(17.0 m)
Omega 18	52.0 feet	(16.0 m)

* Longer lengths may be possible upon request.

Bitumastic® 300 M

PRODUCT DATA SHEET

SELECTION & SPECIFICATION DATA

Generic Type	Coal-tar epoxy polyamide
Description	Renowned high build coal tar epoxy polyamide for protection of steel and concrete in single or two-coat applications in a broad variety of aggressive industrial applications.
Features	• Excellent chemical, corrosion and abrasion resistance • High-build, 16-24 mils (400-610 microns) in a single coat (up to 35 mils with force curing) • Compatible with controlled cathodic protection • Suitable for use in exposures as referenced in the following specifications: • Corp of Engineers C-200, C200a • AWWA C-210 for exterior • SSPC-Paint 16 • Steel Tank Institute Corrosion Control System STI-P3
Color	Black P900 Red P500
Primer	Self-priming, or use suitable prime as recommended by Carboline.
Dry Film Thickness	16 mils (406 microns) in one or two coats Total dry film thickness less than 8 mils (200microns) or in excess of 35 mils (875 microns) is not recommended. Wet-on-wet spray techniques should be used for high thicknesses allowing time for solvents to flash between passes.
Solids Content	By Volume 74% +/- 2%
Theoretical Coverage Rate	1187 ft²/gal at 1.0 mils (29.1 m²/l at 25 microns) 74 ft²/gal at 16.0 mils (1.8 m²/l at 400 microns) Allow for loss in mixing and application.
VOC Values	**As Supplied** : 1.85 lbs/gal 222 g/l Thinner 10 : 10 oz/gal: 2.2 lbs/gal 269 g/l These are nominal values. **Thinner 10: 25 oz/gal: 2.7 lbs/gal 327 g/l** *Maximum thinning for 250 g/l restricted areas is 6 oz/gal.
Dry Temp. Resistance	Continuous: 350°F (177°C) Non-Continuous: 370°F (188°C)
Limitations	Do not use for potable water requirements.
Topcoats	Not recommended
Wet Temp. Resistance	Immersion temperature should not exceed 120°F (49°C)

SUBSTRATES & SURFACE PREPARATION

General	Surfaces must be clean and dry. Employ adequate methods to remove dirt, dust, oil and all other contaminants that could interfere with adhesion of the coating.

SUBSTRATES & SURFACE PREPARATION

Steel	**Immersion:** SSPC-SP10 **Non-Immersion:** SSPC-SP6 SSPC-SP2 or SP3 as minimum requirement. **Surface Profile:** 2.0-3.0 mils (50-75 micron)
Concrete or CMU	Concrete must be cured 28 days at 75°F (24°C) and 50% relative humidity or equivalent. Prepare surfaces in accordance with ASTM D4258 Surface Cleaning of Concrete and ASTM D4259 Abrading Concrete. Voids in concrete may require surfacing.

PERFORMANCE DATA

Test Method	System	Results
ASTM B117 Salt Fog	Blasted Steel 2 cts. 300M	No blistering, rusting or delamination. No measurable undercutting at scribe after 2000 hours
ASTM D2794 Impact	Blasted Steel 2 cts. 300M	Impact site diameter, Inches: 3/8,3/8, 1/2 100 in/lbs Gardner Impactor at 1/2 in. diam.
ASTM D4060 Abrasion	Blasted Steel 2 cts. 300M	130 mg. loss after 1000 cycles, CS17 wheel, 1000 gm load
ASTM D4541 Adhesion	Blasted Steel 2 cts. 300M	1443 psi (Pneumatic)

Test reports and additional data available upon written request. *Disclaimer: Bitumastic 300M is a proprietary formula that is not necessarily formulated to the exact compositional guidelines set forth in some of these standards. Minor deviations that control and improve application characteristics may be present, but does not have a detrimental effect on the suitability for use outlined therein.

MIXING & THINNING

Mixing	Power mix separately, then combine and power mix for a minimum of two minutes. DO NOT MIX PARTIAL KITS.
Thinning	Up to 10 oz/gal (8%) w/ #10 Up to 25 oz/gal (20%) w/ #10 for the first coat application to concrete. Use of thinners other than those supplied or recommended by Carboline may adversely affect product performance and void product warranty, whether expressed or implied.
Ratio	4:1 Ratio (A to B)
Pot Life	75°F (24°C) 2 Hours 90°F (32°C) 1 Hour Pot life ends when coating loses body and begins to sag.

APPLICATION EQUIPMENT GUIDELINES

Listed below are general equipment guidelines for the application of this product. Job site conditions may require modifications to these guidelines to achieve the desired results.

Spray Application (General)	This is a high solids coating and may require adjustments in spray techniques. Wet film thickness is easily and quickly achieved. The following spray equipment has been found suitable and is available from manufacturers such as Binks, DeVilbiss and Graco.
Conventional Spray	Pressure pot equipped with dual regulators, 3/8” I.D. minimum material hose, with 50' maximum material hose .086” I.D. fluid tip and appropriate air cap.

APPLICATION EQUIPMENT GUIDELINES

Listed below are general equipment guidelines for the application of this product. Job site conditions may require modifications to these guidelines to achieve the desired results.

Airless Spray	Pump Ratio: 30:1* GPM Output: 3.0 (min.) Material Hose: ½" I.D. (min.) Tip Size: .023-.035" Output PSI: 2100-2500 Filter Size: 30 mesh *Teflon packings are recommended and available from the pump manufacturer.
Brush & Roller (General)	Recommended for touch up, striping of weld seams and hard-to-coat areas only. Avoid excessive re-brushing or re-rolling.
Brush	Use a medium bristle brush.
Roller	Use a short-nap synthetic roller cover with phenolic core.

APPLICATION CONDITIONS

Condition	Material	Surface	Ambient	Humidity
Minimum	50°F (10°C)	50°F (10°C)	50°F (10°C)	0%
Maximum	90°F (32°C)	125°F (52°C)	110°F (43°C)	90%

Condensation due to substrate temperatures below the dew point can cause flash rusting on prepared steel and interfere with proper adhesion to the substrate. Special application techniques may be required above or below normal application conditions.

CURING SCHEDULE

Surface Temp.	Dry to Touch	Minimum Recoat Time	Maximum Recoat Time	Final Cure Immersion
50°F (10°C)	8 Hours	10 Hours	24 Hours	14 Days
75°F (24°C)	4 Hours	6 Hours	24 Hours	7 Days
90°F (32°C)	2 Hours	3 Hours	24 Hours	5 Days

These times are based on a 16.0 mil (400 micron) dry film thickness. Higher film thickness, insufficient ventilation, high humidity or cooler temperatures will require longer cure times. Excessive humidity or condensation on the surface during curing can interfere with the cure, can cause discoloration and may result in a surface haze. Any haze or blush must be removed by water washing before recoating. If the maximum recoat time is exceeded, the surface must be abraded by sweep blasting prior to the application of additional coats. Holiday Detection (if required): Wet sponge types may be used if the dry film thickness is below 20 mils (500 microns). High voltage spark testing should be used when the dry film thickness exceeds 20 mils (500 microns). Refer to the latest version of NACE SP0188 for specific procedures.

FORCE CURING recommended for thicknesses above 24 mils

Hold substrate at 150 F for 8 hours and material will be ready to handle for immersion service.

CLEANUP & SAFETY

Cleanup	Use #2 Thinner or Acetone. In case of spillage, absorb and dispose of in accordance with local applicable regulations.
Safety	Read and follow all caution statements on this product data sheet and on the SDS for this product. Employ normal workmanlike safety precautions. Hypersensitive persons should wear protective clothing, gloves and use protective cream on face, hands and all exposed areas.

CLEANUP & SAFETY

Caution	This product contains flammable solvents. Keep away from sparks and open flames. All electrical equipment and installations should be made and grounded in accordance with the National Electric Code. In areas where explosion hazards exist, workers should be required to use non-ferrous tools and wear conductive and non-sparking shoes.

PACKAGING, HANDLING & STORAGE

Shelf Life	Part A: Min. 24 months at 75°F (24°C) Part B: Min. 36 months at 75°F (24°C) *Shelf Life: (actual stated shelf life) when kept at recommended storage conditions and in original unopened containers.
Storage Temperature & Humidity	40° -110°F (4°-43°C) 0-100% Relative Humidity
Storage	Store indoors
Shipping Weight (Approximate)	1.25 Gallon Kit - 12 lbs (6 kg) 5 Gallon Kit - 50 lbs (26 kg)
Flash Point (Setaflash)	Part A: 75°F (24°C) Part B: >200°F (93°C)

WARRANTY

To the best of our knowledge the technical data contained herein is true and accurate on the date of publication and is subject to change without prior notice. User must contact Carboline Company to verify correctness before specifying or ordering. No guarantee of accuracy is given or implied. We guarantee our products to conform to Carboline quality control. We assume no responsibility for coverage, performance, injuries or damages resulting from use. Carbolines sole obligation, if any, is to replace or refund the purchase price of the Carboline product(s) proven to be defective, at Carbolines option. Carboline shall not be liable for any loss or damage. NO OTHER WARRANTY OR GUARANTEE OF ANY KIND IS MADE BY CARBOLINE, EXPRESS OR IMPLIED, STATUTORY, BY OPERATION OF LAW, OR OTHERWISE, INCLUDING MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE. All of the trademarks referenced above are the property of Carboline International Corporation unless otherwise indicated.

Attachment B

Photograph 1 – Test pit #1

Photograph 2 – Waste Identified in Test Pit #1

ERM

Photograph 3 – Test pit #2

Photograph 4 – No Waste Identified in Test Pit #2

ERM

Photograph 5 – Test pit #3

Photograph 6 –Waste Identified in Test Pit #3

Appendix D
Sand Bag Removal &
Wetlands Update Proposal

Memorandum

Environmental Resources Management

One Beacon Street, 5th Floor
Boston, MA 02108
+1 617 646 7800
+1 617 267 6440 (fax)

http://www.erm.com

To: Don McElroy, USEPA

Janet Waldron, MassDEP

From: ERM

Date: 20 May 2019

Subject: Iron Horse Park, Operable Unit 3, AOC 3
Sand Bag Removal & Wetlands Update Proposal

On behalf of Pan Am Railways (Pan Am), Environmental Resources Management (ERM) is submitting this update to the project design to incorporate the removal of the existing super sand bags (Super Sacks). The super sand bags were placed to assist in erosion control and water management activities. Their removal will take place at the end of the project once vegetation has been substantially established both on the landfills and in the wetland mitigation area (estimated to be three to four weeks after initial seeding).

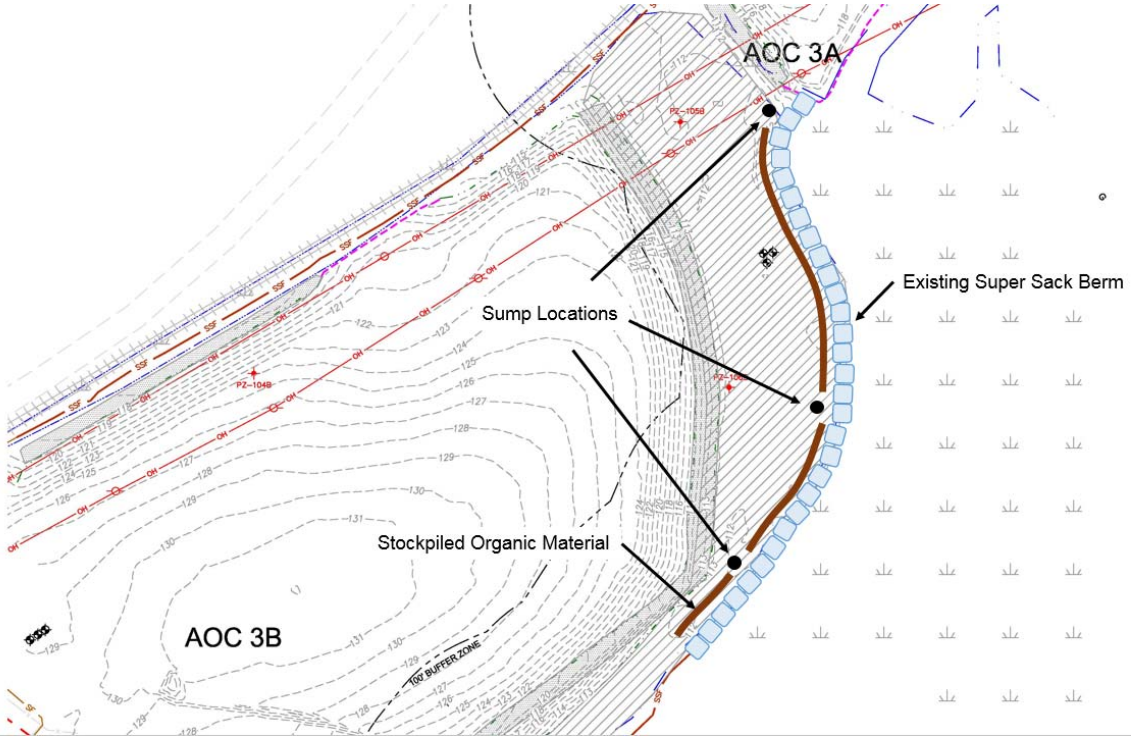
1.0 CONCEPT

The existing Super Sack dam will be reincorporated into the wetland restoration area as a row of elevated hummocks. The plastic wrapping of the Super Sacks will be removed and disposed of offsite. The sand from the Sacks will be left in place, shaped and graded, and covered with one foot of organic soil to form wetland hummocks similar to those placed within the wetland restoration area. The final hummocks will line the eastern boundary of the wetland restoration area. They will each be approximately 50 feet long with gaps of approximately 10 feet in between. These distances will be adjusted in the field to mimic a natural barrier which is not defined by precise measurements. The hummocks will be vegetated with trees and woody species to create areas of forested wetland. Placement of the hummocks and forested wetland along the eastern boundary of the wetland restoration area will aid in slowing the migration of existing *phragmites australis* into the wetland restoration area.

2.0 IMPLEMENTTION

Initial Layout

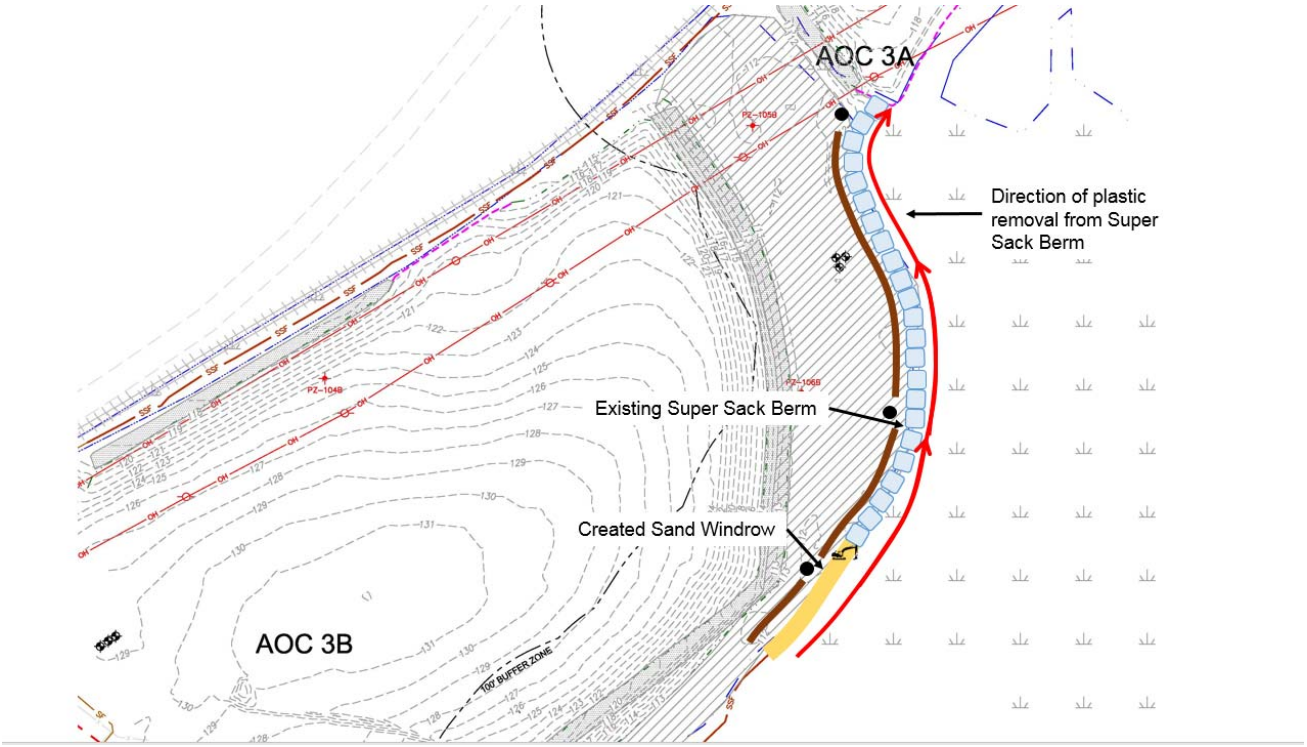
Prior to sandbag removal, organic material will be placed, planted, and seeded throughout the wetland restoration area. Pumping will continue for three to four weeks following planting/seeding to allow seeds to germinate and stabilize the restored wetland. Sumps with pumps will be located directly adjacent to the Super Sack berm on the Eastern site boundary. Organic wetland soil will be stockpiled along the full length of the Super Sack berm as windrow for ease of access. A sketch of this is provided below:



Construction Sequencing

Step 1: Plastic Bag Removal

Beginning at the Southeastern end of the Super Sack berm on AOC 3B, Charter will lift the plastic Super Sacks using the forklift straps and a mini excavator then cut the closeable spout on the bottom for slow and controlled material discharge. The plastic layer will be fully removed, leaving the sand in place as an elevated windrow. The excavator will use this windrow as a pathway to move northward across the wetland, removing Super Sacks one by one. A sketch of this is provided below:



Step 2: Sump Removal

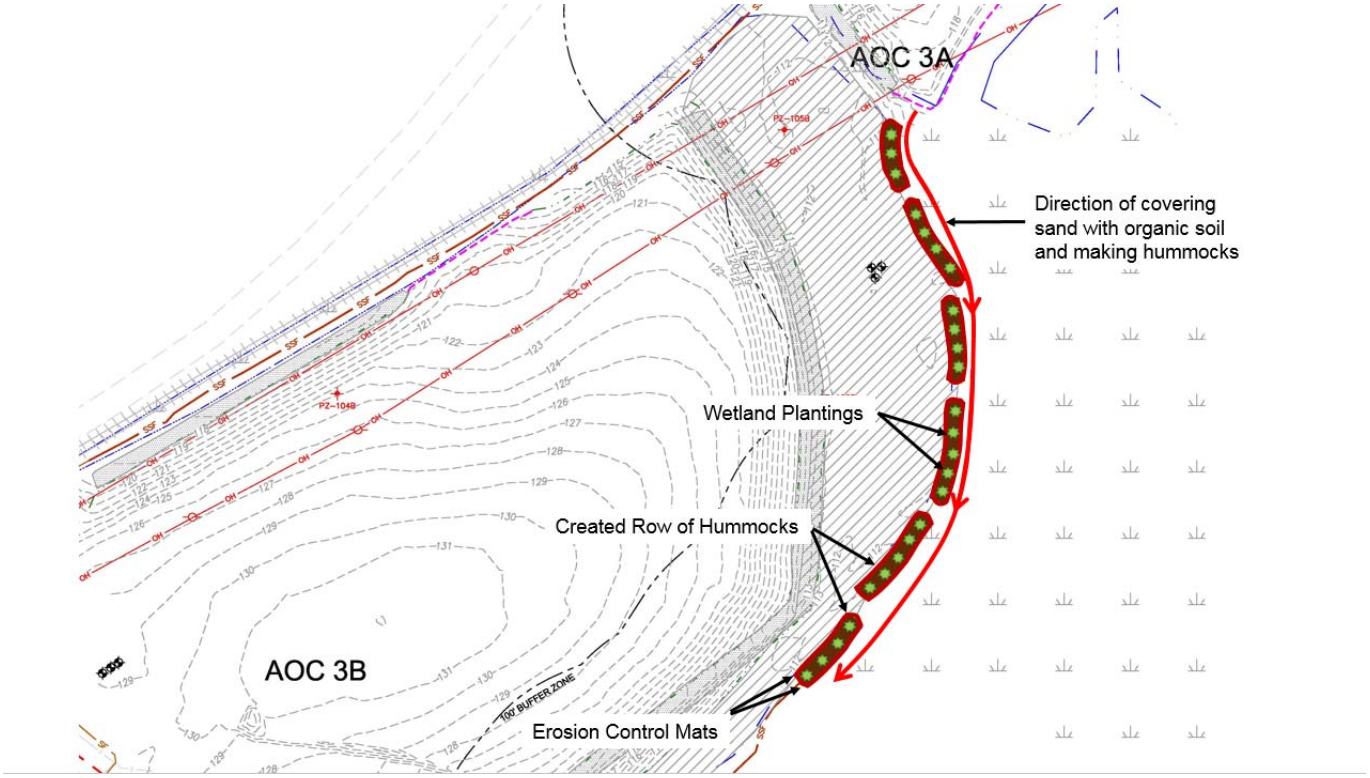
Once all plastic Super Sack wrapping has been removed and sand contents placed, all remaining sumps will be removed from the wetland and the area restored. The sand windrow will again be used as an access pathway to complete this work.

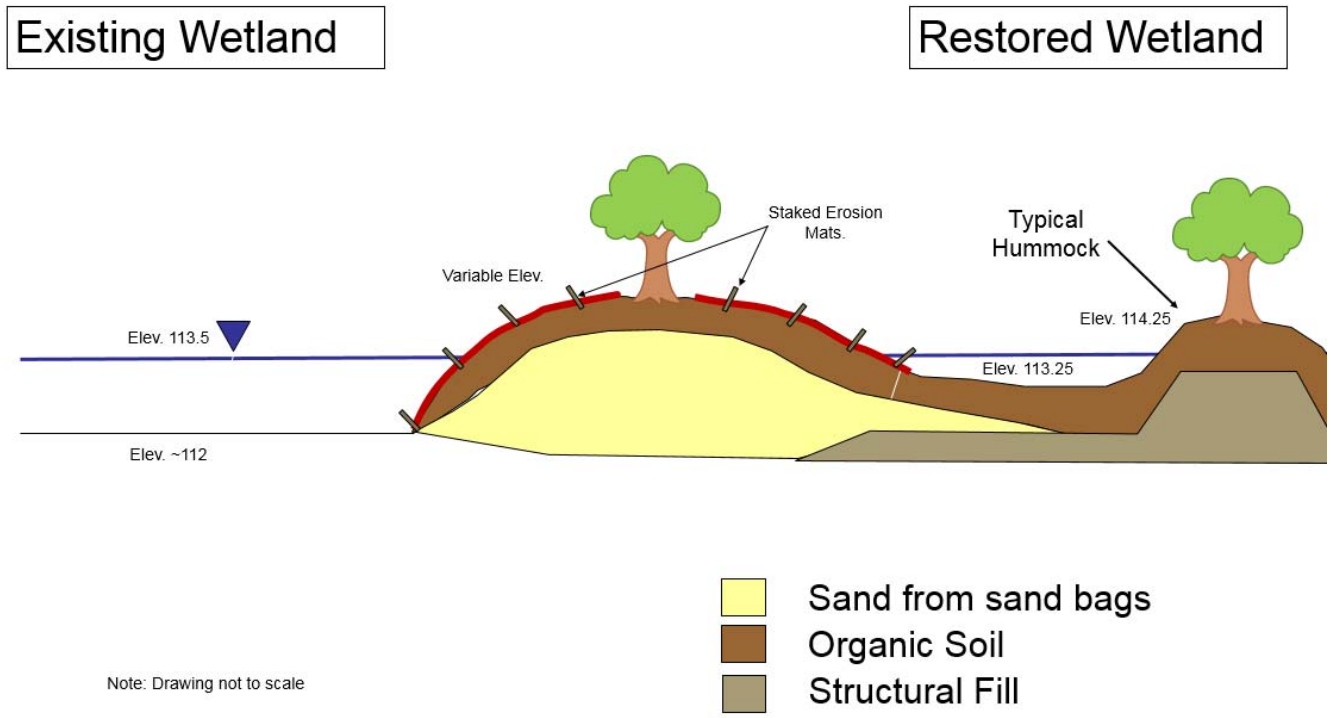
Step 3: Shaping and Organic Soil Placement

To safely travel across the berm, spray painted stakes will be installed on either side for visual aid of the operator. The excavator operator will use the bucket to probe in front of the excavator to ensure the equipment never advances onto material that is too soft to drive onto. Wetland mats will also be available for deployment, if needed. Once advanced, the mini excavator will then be positioned at the northern end of the sand windrow, adjacent to 3A. Erosion mats will be prepared for deployment as an erosion control measure at this time (see attached detail sheet). One end of mats will be staked in at the northern end of the windrow by a ground crew. The excavator will begin to work its way southward, reshaping the windrow into a line of elevated hummocks that run the full extent of the Eastern site boundary. A one foot thick layer of organic soil from the adjacent stockpile will immediately be placed on top of the sand as it is reshaped. As organic material is placed, the ground crew will follow the excavator southward, rolling out erosion mats over both sides of the hummocks. These mats will be staked down with wooden

stakes to contain the organic soil as it is placed and will remain in place until they biodegrade.

The sand windrow will be shaped into hummocks approximately 50 feet in length, separated by gaps approximately 10 feet wide. These low points will allow for hydraulic continuity between the existing and restored wetland areas. The final hummocks will be variable in height (114-116 AMSL) and length to mimic natural conditions and potentially mitigate the spread of *phragmites australis* into the restoration area through the use of plantings that provide shade. A cross section and plan view sketch of this are provided below:





Step 4: Seeding

As soon as construction is complete, SWCA will remobilize to seed the eastern boundary hummocks with a mix of both *New England Wetmix (Wetland Seed Mix)*[1] and *New England Erosion Control/Restoration Mix for Detention Basins and Moist Sites*[2] (or equivalent seed types as deemed acceptable by the ERM Field Engineer). Seeding will be completed by lifting up the erosion control mats, seeding, and then restaking the mats into the hummock. The Wetmix will be spread according to the manufacturer's recommendation (18 pounds per 1 acre). The Erosion Control Mix will be spread at a rate of 9 pounds per 1 acre. By providing a 2 to 1 ratio Wetmix to Erosion Control Mix, the quicker germinating rye species from the Erosion Control Mix will assist in stabilizing the soil, while the wetland species take more time to establish and germinate. Trees will be planted on the hummocks to create additional forested wetland. The erosion mats will be left in place on the new hummocks to decompose naturally.

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[1] New England Wetland Plants Wetmix
(http://newp.com/data/2018/04/WETMIX2018.pdf)

[2] New England Erosion Control/Restoration Mix for Detention Basins and Moist Sites
(http://newp.com/data/2018/08/Moist-site-mix-8132018-no-percent.pdf)

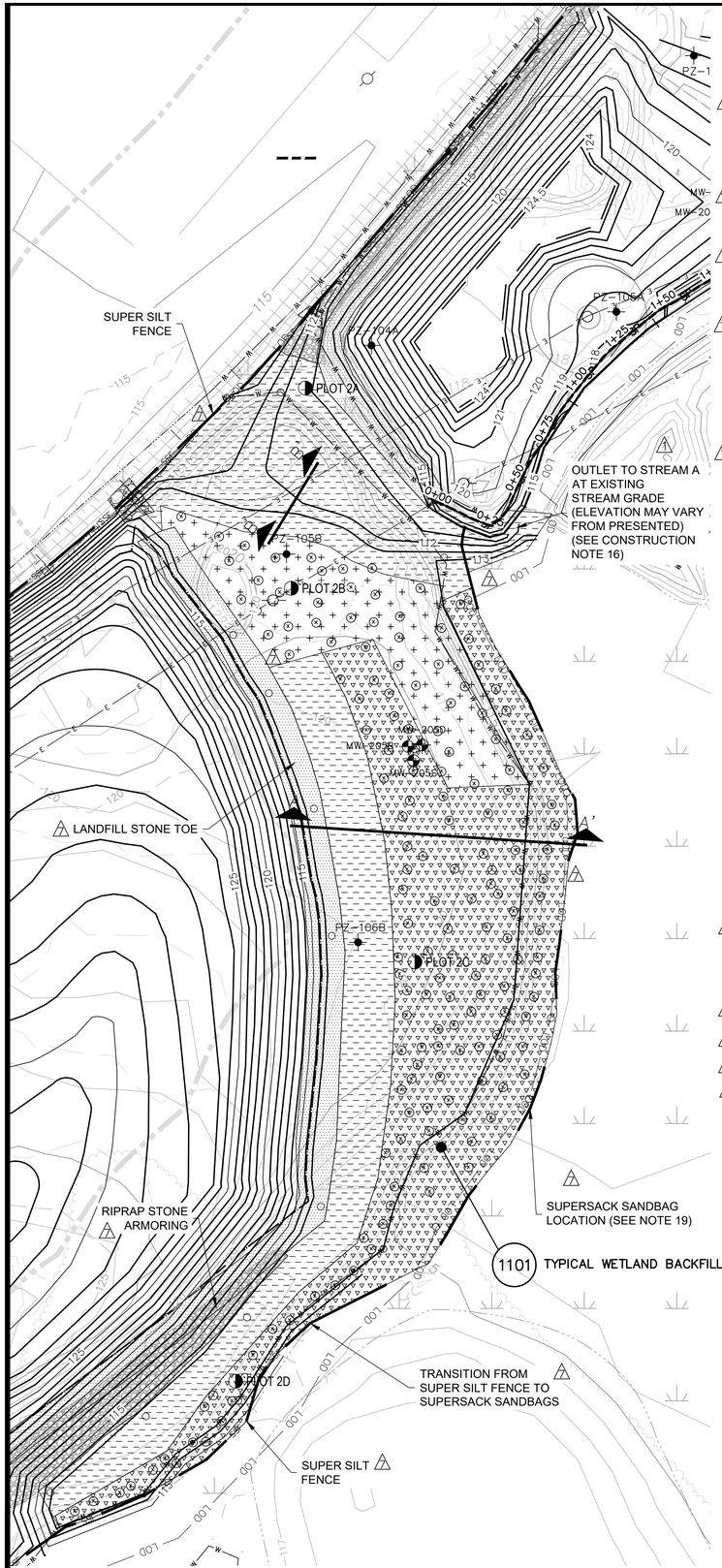
3.0 UPDATES TO WETLAND RESTORATION PLAN

To incorporate the forested wetland being added to the restoration design, some updates were made to the layout of the wetland zones provided in the final design. These updates included switching the easternmost edge from a classification of palustrine emergent (PEM) to palustrine forested (PFO). The seeds and plants specified to PEM and PFO has remained the same, but their physical location has been adjusted as shown on the updated drawing. Switching the zones will both utilize the sand within the super sand bags in hummock construction, as well as create a denser buffer along the outer boundary of newly created wetlands.

In particular, the existing wetland is observed to be predominantly vegetated with *phragmites*. Providing PFO species and their desired subsequent shading will assist in preventing the *phragmites* from out competing the hydrophytic plantings and seed species.

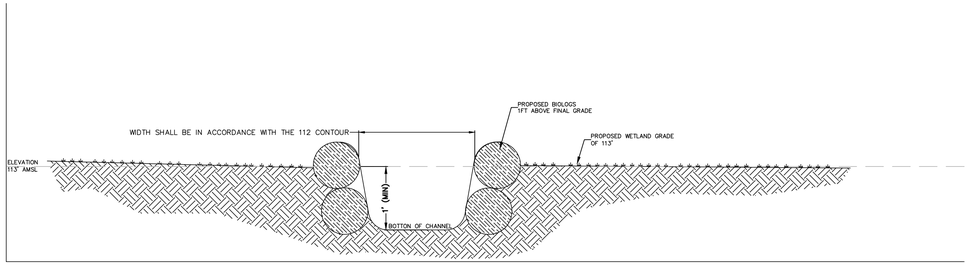
As shown on the updated drawings, the PEM has been moved to the westernmost edge of the created wetland area/toe-of-slope of AOC 3B to maintain the same square footage as originally designed. Maintaining the same square footage is important, as those areas and mitigation ratios were approved when permitting the project with the U.S. EPA and account for the balance of wetland mitigation required for AOCs 1, 2, 3, and 6. If any further adjustments are made or field directed, it is crucial to maintain at least the amount (if not greater) the square footage of the original design of PFO and PSS. PFO and PSS have lower succession rates than that of the PEM areas.

The original palustrine scrub-shrub (PSS) area has remained unchanged from the original design. The PEM designated area located in the northern portion adjacent to AOC 3A has also remained unchanged from the original design.

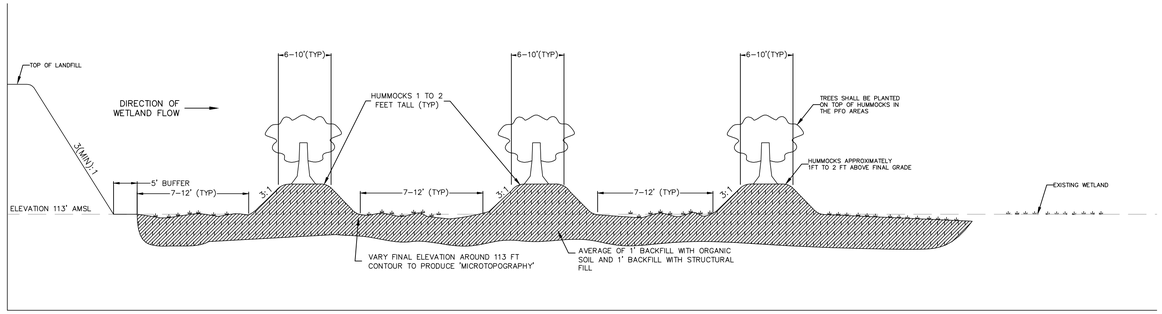


CONSTRUCTION NOTES (FOR AOC 3):

1. WETLANDS EXISTING PRIOR TO CONSTRUCTION TO BE RESTORED TO PRE-CONSTRUCTION ELEVATIONS. WETLAND CREATION AREA ELEVATIONS TO BE CONSTRUCTED AS DEPICTED ON THE DRAWING. MINOR ADJUSTMENTS TO FINAL GRADES SHOULD BE EXPECTED DURING CONSTRUCTION.
2. THE ENGINEER'S WETLAND RESTORATION SPECIALIST SHALL MAKE A FIELD DETERMINATION IF AN ADJUSTMENT IN FINAL GRADES IS NECESSARY TO ENSURE CONTACT WITH GROUNDWATER IN THE ROOT ZONE. HUMMOCKS SHALL BE CLOSER TO 1 FOOT IN HEIGHT IN THE PSS PLANTING ZONE AND CLOSER TO 2 FEET IN THE PFO PLANTING ZONE, AS DIRECTED BY THE ENGINEER'S WETLAND RESTORATION SPECIALIST. THE CONTRACTOR SHALL NOTIFY THE ENGINEER TO ENABLE WETLAND SPECIALIST TO SCHEDULE A SITE INSPECTION AS DECRIBED WITHIN TECHNICAL SPECIFICATION 02937.
3. BRING EXCAVATED AREAS TO GRADE WITH 12 INCHES OF ORGANIC SOIL. ANY MANUFACTURED TOPSOIL APPLIED TO WETLAND AREAS SHALL DOCUMENT COMPOSITION OF AT LEAST 12 PERCENT ORGANIC CARBON CONTENT BY WEIGHT. EQUIPMENT AND VEHICLES SHALL BE PROHIBITED FROM DRIVING OVER THE TOPSOIL AFTER IT HAS BEEN PLACED.
4. THE PLANTABLE TOPSOIL WILL BE A LOAMY, FRIABLE SOIL FREE OF STONES, STUMPS, LARGE STICKS, SHRUBS, SEEDS, AND ROOTS OF EXOTIC/INVASIVE PLANTS, OR OTHER MAN-MADE LITTER. THE WETLAND RESTORATION SPECIALIST WILL APPROVE THE SOIL AS SUITABLE BASED ON A VISUAL INSPECTION PRIOR TO SPREADING IT ON THE SITE. THE CONTRACTOR SHALL COORDINATE WITH ENGINEER AND WETLAND SPECIALIST ACCORDINGLY.
5. FINAL GRADING WILL INCLUDE CREATION OF PLANTABLE HUMMOCKS AS DEPICTED ON SECTION A-A' ON THIS DRAWING, AND OTHER MICROTOPOGRAPHY AS DIRECTED BY THE ENGINEER'S WETLAND RESTORATION SPECIALIST. MICROTOPOGRAPHY WILL BE CREATED BY LEAVING THE ORGANIC SOIL LOOSE AND NOT CREATING A SMOOTH SURFACE AT THE FINAL ELEVATION OF THE WETLAND. HUMMOCKS SIZE AND SPACING SHOWN ON THIS DRAWING ARE REPRESENTATIVE TO DEMONSTRATE THE VARIABLENESS.
6. THE CONTRACTOR'S WETLAND RESTORATION SPECIALIST SHALL MAKE A FIELD DETERMINATION OF THE LOCATION, HEIGHT, AND DENSITY OF THE INDIVIDUAL PLANTABLE HUMMOCKS. COVERAGE OF APPROXIMATELY 35% OF THE CREATED PSS AND PFO WETLANDS SHALL CONTAIN HUMMOCKS.
7. BOULDERS AND COARSE WOODY DEBRIS SUCH AS LOGS AND BRANCHES WILL BE PLACED IN THE CREATED WETLAND AREAS TO PROVIDE ADDITIONAL STRUCTURAL DIVERSITY. BOULDERS AND WOODY DEBRIS WILL BE SALVAGED FROM THE BVW IMPACT AREAS AND CLEARING AS FEASIBLE. COARSE WOODY DEBRIS SHALL BE IN VARIOUS STAGES OF DECOMPOSITION. PLACEMENT OF THE BOULDERS AND COARSE WOODY DEBRIS WILL BE DETERMINED ON THE GROUND BY THE CONTRACTOR'S WETLAND RESTORATION SPECIALIST AND BE SUBJECT TO APPROVAL BY THE ENGINEER'S WETLAND RESTORATION SPECIALIST.
8. THE CONTRACTOR'S WETLAND RESTORATION SPECIALIST SHALL BE RESPONSIBLE FOR INSPECTING ALL PLANT MATERIAL FOR VIABILITY AND SPECIFICATION PRIOR TO PLANTING.
9. DURING INSTALLATION, WOODY PLANT MATERIALS ARE TO BE LOCATED IN CLUSTERS ON TOP OF HUMMOCK SURFACE TO SIMULATE NATURAL DISTRIBUTION PATTERNS AND GROWTH HABITATS AS DETERMINED IN THE FIELD BY THE ENGINEER'S WETLAND RESTORATION SPECIALIST. HUMMOCKS WITHIN THE PFO PLANTING ZONE WILL BE PLANTED WITH A COMBINATION OF TREES AND SHRUBS. NO TREES SHALL BE PLANTED WITHIN 15 FEET OF THE BASE OF THE ENGINEERED CAP.
10. ALL PLANT MATERIALS TO BE PLANTED IN ACCORDANCE WITH BEST HORTICULTURAL PRACTICES OR IN ACCORDANCE WITH ANY SPECIFIC NURSERY SPECIFICATIONS.
11. REMOVE ALL TAGS, RIBBONS, LABELS, ETC AND ALL PLANT CONTAINERS FROM THE SITE AT THE END OF THE PLANTING OPERATION EXCEPT THOSE WHICH IDENTIFY THE SPECIES OF THE WOODY PLANTINGS. TAGS IDENTIFYING THE SPECIES SHALL BE LEFT ON THE PLANTS.
12. WETLAND AREAS WITHIN THE LIMIT OF DISTURBANCE TO BE SEEDED WITH SPECIFIED SEED MIX OR SUBSTITUTE MIX APPROVED BY THE ENGINEER'S WETLAND RESTORATION SPECIALIST IMMEDIATELY FOLLOWING FINAL GRADING OF TOPSOIL. SEED APPLICATION METHODS AND RATES ARE TO FOLLOW VENDOR SPECIFICATIONS (SEE TECHNICAL SPECTICATION 02937).
13. CONTRACTOR TO GUARANTEE ALL WETLAND PLANTS AS DESCRIBED IN TECHNICAL SPECIFICATION 02937. ALL FAILED WETLAND PLANTS SHALL BE REPLACED IN KIND BY THE WETLAND PLANTING CONTRACTOR AT NO ADDITIONAL COST TO THE OWNER. IF SUBSTITUTIONS ARE PROPOSED, THE ENGINEER'S WETLAND RESTORATION SPECIALIST MUST APPROVE THE PLANT TYPE, SIZE, AND NUMBER PRIOR TO PLANTING.
14. IN AREAS WHERE WETLANDS ARE TEMPORARY IMPACTED DURING REMEDIAL ACTION THEN RESTORED, VEGETATION PLANTING AND DENSITIES MAY BE MODIFIED BY THE ENGINEER'S WETLAND RESTORATION SPECIALIST BASED ON A FIELD REVIEW OF THE LEVEL OF DISTURBANCE IN EACH WETLAND AREA.
15. THE BANKS OF THE CREATED STREAM CHANNEL WITHIN PEM WETLAND SHALL CONSIST OF TWO (2) STACKED COIR FIBER BIOLOGS – A 12-INCH BIOLOG ON THE BOTTOM AND A 12-INCH BIOLOG STACKED ON TOP OF IT – TO CREATE A NEARLY VERTICAL STREAM BANK WITH A TOP ELEVATION ONE FOOT HIGHER THAN THE SURROUNDING GROUND SURFACE ELEVATION. SEE STREAM BANK CROSS SECTION B-B'. THE TOP OF THE 12-INCH BIOLOG SHALL BE PLANTED PER THE PLANTING SCHEDULE.
16. THE FINAL CONTOURS OF THE WETLAND MAY BE FIELD ADJUSTED TO ALLOW THE WETLAND TO BE TIED INTO STREAM A AS APPROVED BY THE ENGINEER.
17. TREES SHALL BE PLANTED ON TOP OF THE HUMMOCKS IN THE PFO AREAS. AS DESCRIBED IN TECHNICAL SPECIFICATION 02937, SUB-SOIL AMENDMENTS SHALL BE ADDED IN EACH TREE HOLE THAT IS DUG PRIOR TO PLANTING.
18. HUMMOCKS CONSTRUCTION CAN INCLUDE STRUCTURAL FILL AT ELEVATIONS BELOW THE TOP 12 INCHES OF ORGANIC SOIL.
19. TO RESTORE THE WETLAND BETWEEN THE SUPERSACK SANDBAGS LOCATION AND THE EXISTING WETLAND, THE CONTRACTOR SHALL REMOVE THE SUPERSACK SANDBAGS BY SPREADING THE SAND OVER THE EXISTING WETLAND MATERIAL AND COVERING WITH 1 FT MINIMUM OF ORGANIC MATERIAL TO CONSTRUCT HUMMOCKS WITH ELEVATIONS 114-116 AMSL BETWEEN THE TRANSITION OF THE RESTORED WETLAND AND THE UNDISTURBED WETLAND. THIS WORK SHALL BE PERFORMED IN ACCORDANCE WITH AN APPROVED SANDBAG REMOVAL PLAN. SEE "SANDBAG REMOVAL & WETLANDS UPDATE PROPOSAL" DATED 15 MAY 2018 FOR ADDITIONAL REQUIREMENTS.



TYPICAL STREAM CHANNEL CROSS SECTION B-B'
(NOT TO SCALE)



TYPICAL WETLAND CROSS SECTION A-A'
(NOT TO SCALE)

AOC 3 WETLAND LEGEND AND PLANTING SCHEDULE

LEGEND

PLANTING SCHEDULE

Zone	Planting Area (square feet)	Common Name	Scientific Name	Form	Height	Quantity	Spacing (Feet O.C)
					Plants and Seeding		
Palustrine Scrub-Shrub Wetland (PSS)	6,560 (Created Wetland)	Elderberry	*Sambucus Canadensis*	Container	3'-4'	20	10
		Highbush blueberry	*Vaccinium corymbosum*	Container	3'-4'	20	10
		Speckled alder	*Alnus incana ssp. rugosa*	Container	3'-4'	20	10
		Arrowwood	*Viburnum dentatum*	Container	3'-4'	20	10
		Soft rush	*Juncus effusus*	2" Plugs		100	5
		Lurid sedge	*Carex lurida*	2" Plugs		100	5
		New England Wetland Plants (or equivalent)		Wetmix	Apply at manufacturers recommended rate		Entire zone
Palustrine Forested Wetland (PFO)	18,774 (Created Wetland)	Red maple	*Acer rubrum*	Container	4'-6'	25	15
		Black Willow	*Salix nigra*	Container	3'-4'	25	15
		Sycamore	*Platanus occidentalis*	Container	4'-6'	40	15
		Box-elder	*Acer negundo*	Container	4'-6'	30	15
		Arrowwood	*Viburnum dentatum*	Container	3'-4'	30	10
		Soft rush	*Juncus effusus*	2" Plugs		200	5
		Lurid sedge	*Carex lurida*	2" Plugs		200	5
		New England Wetland Plants (or equivalent)		Wetmix	Apply at manufacturers recommended rate		Entire zone
Palustrine Emergent Marsh (PEM)	16,230 (10,246 Restored Wetland plus 5,984 Created Wetland)	Soft rush	*Juncus effusus*	2" Plugs		150	5
		Fringed sedge	*Carex crinate*	2" Plugs		75	5
		Pickerelweed	*Pontederia cordata*	2" Plugs		75	5
		Canada rush	*Juncus canadensis*	2" Plugs		150	5
		Sensitive fern	*Onoclea sensibilis*	2" Plugs		50	5
		Lurid sedge	*Carex lurida*	2" Plugs		150	5
		New England Wetland Plants (or equivalent)		Wetmix	Apply at manufacturers recommended rate		Entire zone
	Plantings immediately behind	Passy willow	*Salix discolor*	Tubelings		25	2
		Speckled	*Alnus incana*	Container	3'-4'	25	2

LEGEND

- MONITORING WELL LOCATION
- PIZOMETER LOCATION
- SACARPHA TRANSMISSION POLE
- 110 — EXISTING INDEX CONTOUR (5' INTERVAL)
- EXISTING INTERMEDIATE CONTOUR (1' INTERVAL)
- 120 — PROPOSED FINAL CONTOUR
- LOD — LIMIT OF DISTURBANCE
- LIMIT OF CAP
- WETLAND
- OPEN WATER/STREAMS/PONDS
- W — W — BORDERING VEGETATED WETLAND
- NON-JURISDICTIONAL STREAM
- MEAN ANNUAL HIGH WATER
- TREE LINE
- EXISTING FENCE
- SP — SHEET PILE
- E — E — POWER TRANSMISSION LINE
- NATIONAL GRID TRANSMISSION POLE
- RAILROAD TRACK
- HUMMOCKS (GENERAL AREA NOT LOCATIONS)
- LONG-TERM WETLAND SAMPLING PLOT

N

0 30 60
SCALE (IN FEET)

NOTES:

1. SEE DRAWING NO. 01 FOR GENERAL NOTES, ABBREVIATIONS AND LEGEND.
2. SEE EROSION CONTROLS ON DRAWINGS NO. 04.

Rev.	Date	Description	By	Chk
5	05/20/2019	UPDATE WETLAND RESTORATION	MP	DQ
4	11/15/2018	UPDATE FOR SHEET PILE REFUSAL	MP	DQ
3	10/11/2018	UPDATED EXISTING CONTOURS PER PRE-CONSTRUCTION SURVEY	MP	DQ
2	8/13/2018	AOC 3 CONSTRUCTION DRAWINGS	MP	DQ
1	7/27/2018	AOC 3 CONSTRUCTION DRAWINGS	MP	DQ
0	7/17/2018	AOC 3 CONSTRUCTION DRAWINGS	MP	DQ
A	7/13/2018	AOC 3 DRAFT CONSTRUCTION DRAWINGS	MP	DQ

DRAWN BY MRL | CADD Review MP | CHECKED BY DQ

Environmental Resources Management

PAN AM RAILWAYS IRON HORSE PARK

BILLERICA, MASSACHUSETTS

AOC 3 WETLAND RESTORATION PLAN

SCALE	PROJECT NUMBER	DRAWING	REV.
AS NOTED	0433434	07	7
DATE DRAWN 9/12/2012			

Proud Member and Participant of:
www.eastcoasterosion.com
443 Bricker Road Bernville, PA 19506
1.800.582.4005 +1.610.488.8496 Fax +1.610.488.8494

Material and Performance Specification

ECC-2B™ Double Net Coconut Biodegradable Rolled Erosion Control Product

Description:

The ECC-2B™ is made with uniformly distributed 100% coconut fiber and two organic jute nets securely sewn together with biodegradable thread. The tightly compressed blankets are wrapped and include a product label, code and installation guide. The blankets are palletized for easy transportation.
The ECC-2B™ has functional longevity of approximately 24 months, but will vary depending on soil and climatic conditions, and is suitable for slopes 1:1 and medium to high flow channels. The ECC-2B™ meets Type 4 specification requirements established by the Erosion Control Technology Council (ECTC) and Federal Highway Administration's (FHWA) FP-03 Section 713.17.

Matrix:	1	2
	100% Coconut	

Netting:	Type	Net Color
Top:	Organic Leno Weave Jute	Natural
Middle:	None	
Bottom:	Organic Leno Weave Jute	

Net Opening:	Top	Middle	Bottom
	0.5" x 1.0"		0.5" x 1.0"

Thread:	Type	Color
	Biodegradable Thread	Natural

Roll Sizes:	Standard	"A" Size	Mega
Width:	8 ft 2.4 m	4 ft 1.2 m	16 ft 4.9 m
Length:	112.5 ft 34.3 m	225 ft 68.6 m	112.5 ft 34.3 m
Weight*:	60 lbs 27.2 kg	60 lbs 27.2 kg	120 lbs 54.4 kg
Area:	100 yd^2 83.6 m^2	100 yd^2 83.6 m^2	200 yd^2 167.2 m^2
#/Pallet:	20	6	20

*Weight at time of manufacturing.

Index Value Properties*:

Property	Test Method	Typical	
Mass/Unit Area	ASTM D6475	9.50 oz/yd^2	322.1 g/m2
Thickness	ASTM D6525	0.23 in	5.84 mm
Tensile Strength-MD	ASTM D6818	223 lb/ft	3.25 kN/m
Elongation-MD	ASTM D6818	11 %	
Tensile Strength-TD	ASTM D6818	150 lb/ft	2.19 kN/m
Elongation-TD	ASTM D6818	16.0 %	
Light Penetration	ASTM D6567	13 %	
Density / Specific Gravity	ASTM D792	N/A g/cm^3	
Water Absorption	ASTM D1117	340 %	

*May differ depending upon raw material variations

Bench-Scale Testing* (NTPEP***):

Test Method	Parameters	Results
ECTC Method 2 Rainfall	50mm (2in) / hr-30 min	SLR**=14.16
	100mm (4in) / hr-30 min	SLR**=18.25
	150mm (6in) / hr-30 min	SLR**=23.24
ECTC Method 3 Shear Resistance	Shear at .50 in soil loss	2.76 lb/ft^2
ECTC Method 4 Germination	Top soil; Fescue; 21 day incubation	501 %

*Bench scale tests should not be used for design purposes.

**Soil Loss Ratio=Soil Loss Bare Soil/Soil Loss with RECP=1/C-Factor

***The preceding test data excerpts were reproduced with the permission of AASHTO, however, this does not constitute endorsement or approval of the product, material or device by AASHTO

Slope Performance Design Values*:

Property	Test Method		Value
C-Factors	ASTM D6459		0.04
Slope Length (L)	**≤ 3:1**	**3:1-2:1**	**≥ 2:1**
< 50 ft (15 m)	0.040	0.053	0.102
50 ft – 100 ft	0.060	0.084	0.120
>100 ft (30 m)	0.094	0.114	0.134

*Large-Scale Results obtained by 3rd Party GAI Accredited Independent Laboratory

Channel Performance Design Values*:

Property	Test Method	Value			
Unvegetated Shear Stress	ASTM D 6460	2.25	lbs/ft^2	107.73	Pa
Unvegetated Velocity	ASTM D 6460	9.0	ft/s	2.74	m/s
Vegetated Shear Stress	NA	N/A	lbs/ft^2	N/A	Pa
Vegetated Velocity	NA	N/A	ft/s	N/A	m/s
Manning's N (Value Represents a Range)		0.025			

*Large-Scale Results obtained by 3rd Party GAI Accredited Independent Laboratory

Revised 1/11/2016

Appendix E
Geotextile QA/QC Testing Results

US CONSTRUCTION FABRICS LLC
8 Ledge Rd, Windham, NH 03087 (603) 893-5480, Fax (603) 893-2154
www.usconstructionfabrics.com
Wholesale Distribution
CONSTRUCTION FABRICS, LINERS, & ENVIRONMENTAL PRODUCTS

Geotextile Product Description Sheet

SKAPS GT-180
Nonwoven Geotextile

SKAPS GT-180 is a needle-punched nonwoven geotextile made of 100% polypropylene staple fibers, which are formed into a random network for dimensional stability. SKAPS GT-180 resists ultraviolet deterioration, rotting, biological degradation, naturally encountered basics and acids. Polypropylene is stable within a pH range of 2 to 13. SKAPS GT-180 conforms to the physical property values listed below:

PROPERTY	TEST METHOD	UNIT	M.A.R.V. (Minimum Average Roll Value)
Weight (Typical)	ASTM D 5261	oz/yd^2 (g/m^2)	8.0 (271)
Grab Tensile	ASTM D 4632	lbs (kN)	205 (0.911)
Grab Elongation	ASTM D 4632	%	50
Trapezoid Tear Strength	ASTM D 4533	lbs (kN)	85 (0.378)
CBR Puncture Resistance	ASTM D 6241	lbs (kN)	535 (2.38)
Permittivity*	ASTM D 4491	sec^{-1}	1.35
Water Flow*	ASTM D 4491	gpm/ft^2 (l/min/m^2)	90 (3657)
AOS*	ASTM D 4751	US Sieve (mm)	80 (0.180)
UV Resistance	ASTM D 4355	%/hrs	70/500

PACKAGING	
Roll Dimensions (W x L) – ft	12.5 x 360 / 15 x 300
Square Yards Per Roll	500
Estimated Roll Weight - lbs	250

* At the time of manufacturing. Handling may change these properties.

This information is provided for reference purposes only and is not intended as a warranty or guarantee. SKAPS assumes no liability in connection with the use of this information.

Made in U.S.A.

12/23/09

Product : GT180-180

ROLL # ASTM METHOD UNITS TARGET	MD TENSILE D4632 lbs. 205	MD ELONG D4632 % 50	XMD TENSILE D4632 lbs 205	XMD ELONG D4632 % 50	MD TRAP D4533 lbs. 85	XMD TRAP D4533 lbs 85	CBR PUNCTURE D6241 lbs. 535	AOS D4751 US Sieve 80	WATER FLOW D4491 gpm/ft^2 95	PERMITTIVITY D4491 sec^{-1} 1.40
050538545	210	75	238	91	95	105	594	80	123	1.64
050538546	210	75	238	91	95	105	594	80	123	1.64
050538547	210	75	238	91	95	105	594	80	123	1.64
050538548	210	75	238	91	95	105	594	80	123	1.64
050538549	210	75	238	91	95	105	594	80	123	1.64
050538550	210	75	238	91	95	105	594	80	123	1.64
050538551	210	75	238	91	95	105	594	80	123	1.64
050538552	210	75	238	91	95	105	594	80	123	1.64
050538557	210	75	238	91	95	105	594	80	123	1.64
050538558	210	75	238	91	95	105	594	80	123	1.64
050538559	210	75	238	91	95	105	594	80	123	1.64
050538561	210	75	238	91	95	105	594	80	123	1.64
050538570	207	74	249	93	111	143	596	80	136	1.82
050538571	207	74	249	93	111	143	596	80	136	1.82
050538572	207	74	249	93	111	143	596	80	136	1.82
050538574	207	74	249	93	111	143	596	80	136	1.82
050538575	207	74	249	93	111	143	596	80	136	1.82
050538576	207	74	249	93	111	143	596	80	136	1.82
050538577	207	74	249	93	111	143	596	80	136	1.82
050538578	207	74	249	93	111	143	596	80	136	1.82
050538579	207	74	249	93	111	143	596	80	136	1.82
050538586	207	74	249	93	111	143	596	80	136	1.82
050538587	207	74	249	93	111	143	596	80	136	1.82
050538588	207	74	249	93	111	143	596	80	136	1.82
050538589	207	74	249	93	111	143	596	80	136	1.82
050538590	207	74	249	93	111	143	596	80	136	1.82
050538591	207	74	249	93	111	143	596	80	136	1.82
050538592	207	74	249	93	111	143	596	80	136	1.82
050538593	207	74	249	93	111	143	596	80	136	1.82
050538594	246	82	237	100	104	128	630	80	136	1.82
050538595	246	82	237	100	104	128	630	80	136	1.82
050538596	246	82	237	100	104	128	630	80	136	1.82
050538597	246	82	237	100	104	128	630	80	136	1.82
050538598	246	82	237	100	104	128	630	80	136	1.82
050538599	246	82	237	100	104	128	630	80	136	1.82
050538600	246	82	237	100	104	128	630	80	136	1.82

* All values are MARV.

Product : GT180-180

ROLL # ASTM METHOD UNITS TARGET	MD TENSILE D4632 lbs. 205	MD ELONG D4632 % 50	XMD TENSILE D4632 lbs 205	XMD ELONG D4632 % 50	MD TRAP D4533 lbs. 85	XMD TRAP D4533 lbs 85	CBR PUNCTURE D6241 lbs. 535	AOS D4751 US Sieve 80	WATER FLOW D4491 gpm/ft^2 95	PERMITTIVITY D4491 sec^{-1} 1.40
050538601	246	82	237	100	104	128	630	80	136	1.82
050538602	246	82	237	100	104	128	630	80	136	1.82
050538603	246	82	237	100	104	128	630	80	136	1.82
050538604	246	82	237	100	104	128	630	80	136	1.82
050538605	246	82	237	100	104	128	630	80	136	1.82
050538606	246	82	237	100	104	128	630	80	136	1.82
050538607	246	82	237	100	104	128	630	80	136	1.82
050538608	246	82	237	100	104	128	630	80	136	1.82
050538609	246	82	237	100	104	128	630	80	136	1.82
050538610	246	82	237	100	104	128	630	80	136	1.82
050538612	246	82	237	100	104	128	630	80	136	1.82
050538613	246	82	237	100	104	128	630	80	136	1.82
050538614	246	82	237	100	104	128	630	80	136	1.82
050538615	246	82	237	100	104	128	630	80	136	1.82
050538616	246	82	237	100	104	128	630	80	136	1.82
050538617	246	82	237	100	104	128	630	80	136	1.82
050538618	246	82	237	100	104	128	630	80	136	1.82
050538621	220	76	241	100	107	133	595	80	136	1.82
050538622	220	76	241	100	107	133	595	80	136	1.82
050538624	220	76	241	100	107	133	595	80	136	1.82
050538631	220	76	241	100	107	133	595	80	136	1.82
050538635	220	76	241	100	107	133	595	80	136	1.82
050538636	220	76	241	100	107	133	595	80	136	1.82
050538639	220	76	241	100	107	133	595	80	136	1.82
050538640	220	76	241	100	107	133	595	80	136	1.82
050538642	220	76	241	100	107	133	595	80	136	1.82
050538652	209	87	289	95	107	124	614	80	136	1.82
050538659	209	87	289	95	107	124	614	80	136	1.82
050538663	209	87	289	95	107	124	614	80	136	1.82
050538664	209	87	289	95	107	124	614	80	136	1.82
050538665	209	87	289	95	107	124	614	80	136	1.82
050538666	209	87	289	95	107	124	614	80	136	1.82

* All values are MARV.

Appendix F
Geomembrane QA/QC Testing Results

Geocomposite Drainage Layer Product Information

CHENANGO CONTRACTING, INC

29 Arbutus Rd.
Johnson City, NY 13790
T: (607) 729-8500
F: (607) 729-2415
www.chenangocontracting.com

September 6, 2018

Mr. Chris Ryan
Charter Contracting Company
500 Harrison Ave Suite 4R
Boston, MA 02118

Subject: Iron Horse Park AOC 3
Geocomposite Submittal

Dear Mr. Ryan:

Please find attached submittal information for the proposed Geocomposite, GSE TrxNet 340mil w/8oz. Please see the attached GSE Manufacturing QA Manual, Installation QA Manual, and Material Properties Sheet.

If you have any questions concerning this submittal please do not hesitate to contact me.

Sincerely,
CHENANGO CONTRACTING, INC.

Nicholas S. Brechko

Attachments Physical Properties Sheet
GSE Submittal Literature

PRODUCT DATA SHEET

GSE TrxNet 340 mil Geocomposite

GSE TrxNet geocomposite consists of a 340 mil thick GSE TrxNet geonet heat-laminated on one or both sides with a GSE nonwoven needle-punched geotextile. The geotextile is available in mass per unit area range of 6 oz/yd² to 16 oz/yd². The geocomposite is designed and formulated to perform drainage function under a range of anticipated site loads, gradients and boundary conditions.

AT THE CORE:

A 340 mil thick TrxNet geonet heat-laminated on one or both sides with a nonwoven needlepunched geotextile.

Product Specifications

Tested Property	Test Method	Frequency	Minimum Average Roll Value[1]		
Geocomposite			6 oz/yd²	8 oz/yd²	10 oz/yd²
Transmissivity[2], gal/min/ft, (m²/sec) Double-Sided Composite Single-Sided Composite	ASTM D 4716	1/540,000 ft²	19.3 (4x10⁻³) 24.1 (5x10⁻³)	19.3 (4x10⁻³) 24.1 (5x10⁻³)	17.4 (3.5x10⁻³) 21.7 (4.5x10⁻³)
Ply Adhesion, lb/in	ASTM D 7005	1/50,000 ft²	0.5	0.5	0.5
Geonet Core[3] – GSE TrxNet					
Geonet Core Thickness, mil	ASTM D 5199	1/50,000 ft²	340	340	340
Transmissivity[2], gal/min/ft (m²/sec)	ASTM D 4716		48.3 (1 x 10⁻²)	48.3 (1 x 10⁻²)	48.3 (1 x 10⁻²)
Density, g/cm³	ASTM D 1505	1/50,000 ft²	0.94	0.94	0.94
Tensile Strength (MD), lb/in	ASTM D 7179	1/50,000 ft²	80	80	80
Carbon Black Content, %	ASTM D 4218	1/50,000 ft²	2.0	2.0	2.0
Geotextile[3]					
Mass per Unit Area, oz/yd²	ASTM D 5261	1/90,000 ft²	6	8	10
Grab Tensile Strength, lb	ASTM D 4632	1/90,000 ft²	160	220	260
Grab Elongation	ASTM D 4632	1/90,000 ft²	50%	50%	50%
CBR Puncture Strength, lb	ASTM D 6241	1/540,000 ft²	435	575	725
Trapezoidal Tear Strength, lb	ASTM D 4533	1/90,000 ft²	65	90	100
AOS, US sieve[1], (mm)	ASTM D 4751	1/540,000 ft²	70 (0.212)	80 (0.180)	100 (0.150)
Permittivity, sec⁻¹	ASTM D 4491	1/540,000 ft²	1.5	1.3	1.0
Water Flow Rate, gpm/ft²	ASTM D 4491	1/540,000 ft²	110	95	75
UV Resistance, % retained	ASTM D 4355 (after 500 hours)	per formulation	70	70	70
NOMINAL ROLL DIMENSIONS[4]					
Roll Width, ft			15	15	15
Roll Length, ft	Double-Sided Composite Single-Sided Composite		160 170	150 170	140 160
Roll Area, ft²	Double-Sided Composite Single-Sided Composite		2400 2550	2250 2550	2100 2400

NOTES:

- [1]All geotextile properties are minimum average roll values except AOS which is maximum average roll value and UV resistance is typical value. Geonet core thickness is nominal value.
- [2]Gradient of 0.1, normal load of 10,000 psf, water at 70˚F between steel plates for 15 minutes. Contact GSE for performance transmissivity value for use in design.
- [3]Component properties prior to lamination.
- [4]Roll widths and lengths have a tolerance of ±1%.

GSE is a leading manufacturer and marketer of geosynthetic lining products and services. We've built a reputation of reliability through our dedication to providing consistency of product, price and protection to our global customers.

Our commitment to innovation, our focus on quality and our industry expertise allow us the flexibility to collaborate with our clients to develop a custom, purpose-fit solution.

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For more information on this product and others, please visit us at GSEworld.com, call 800.435.2008 or contact your local sales office.

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GEONET & GEOCOMPOSITE PRODUCTS

MANUFACTURING QUALITY ASSURANCE MANUAL

Contents

1.0 INTRODUCTION

This manual provides an overview of the GSE Manufacturing Quality Assurance Program for GSE geonet and geocomposite products. It is intended for use by GSE's customers to enhance their understanding of the quality system under which GSE geonet and geocomposite products are manufactured.

2.0 COMMITMENT TO QUALITY

GSE is committed to meeting or exceeding customer's requirements and industry standards. This commitment to quality is established through a documented quality management system, continuous employee training, investment in technology and emphasis on process control. GSE has allocated resources to ensure that this commitment to quality translates into the best products and services for its customers.

3.0 MANUFACTURING QUALITY ASSURANCE

GSE has an on-site quality assurance laboratory at each manufacturing facility worldwide. Each facility has a fully equipped, well staffed, dedicated laboratory with strict guidelines to maintain a high level of quality and up-to-the-minute results on GSE's finished products.

GSE has a rigorous set of minimum standards and an effective test program to assure compliance has been established. These procedures and requirements are frequently reviewed and adjusted to assure compliance with current market demands and/or predetermined project specifications. Also raw materials and process parameters are controlled to provide products complying with GSE's minimum characteristics and regulatory standards.

4.0 MANUFACTURING QUALITY ASSURANCE ORGANIZATION

GSE quality assurance department assures that only products meeting GSE and/or the customer's requirements are released for shipment. The quality assurance personnel are directly responsible for monitoring, testing, and providing feedback to the manufacturing department ensuring the production of the specified product quality. Each member of the quality assurance team must participate in detailed training that includes factory exposure.

The GSE quality assurance team consists of the manufacturing quality assurance laboratories, engineering staff and manufacturing personnel. The combination of expertise and experience from these groups provide GSE with the proper tools to maintain the highest level of product quality and customer service in the industry.

5.0 STAFF & SCHEDULING

The quality assurance laboratories are staffed during any manufacturing run. A continuous communication link is maintained between the laboratory and manufacturing personnel, maximizing production efficiency and product quality.

6.0 PRODUCT IDENTIFICATION & DOCUMENTATION

A. Roll Numbering

Each roll of geonet and geocomposite is assigned a unique roll number. The quality assurance laboratory maintains records documenting the raw materials and resulting product quality information.

B. Approval Procedure

Results for each tested roll of product are checked against both GSE and customer's specifications for compliance. The quality assurance laboratory approves those materials that meet these requirements for shipment.

C. Non-Conformance

Material that does not meet GSE's minimum standards or customer's specifications is given a roll number, but is rejected and separated from the approved material. The rejected material is then identified as non-conformaning and will not be used. Material that meets GSE's minimum standards, but does not meet a stricter customer's specification will not be allocated to that customer, but will be placed into inventory as a GSE's standard material.

D. Documentation

Quality assurance certificates are generated and supplied for each roll of geonet and geocomposite product to include all relevant quality assurance information about the material. The geotextile components of the drainage geocomposite materials are tracked throughout the manufacturing process. Therefore, traceability reports are available.

7.0 RECORDS RETENTION

GSE maintains reports and/or samples for products produced and sold. Records and/or samples are maintained according to GSE's standard retention policy as outlined below.

MATERIAL	ITEM	YEAR
Raw Materials	Resin Supplier Test Reports and Certifications GSE Resin Test Reports Resin Sample Retain (Archive)	≥ 2 ≥ 2 ≥ 2
Geonets and Geocomposites	Raw Test Data (in computer database) Qualty Control Certificates (in computer database) Sample Retain (approximately one square foot)	≥ 5 ≥ 5 ≥ 5

8.0 TESTING CAPABILITIES

GSE maintains high capacity, state-of-the-art laboratory equipment suitable for performing the procedures in Houston, Texas, and Kingstree, South Carolina. Both quality assurance laboratories are accredited by the GAI-LAP Program. The appropriate certificates are maintained for review upon request by authorized parties.

A. Routine Testing

GSE has developed a strict quality assurance program, which exceeds all industry's standard practices and/or customer's specifications. The testing program covers raw materials and finished goods and is adhered to by all GSE's quality assurance laboratories. The laboratory equipment used by GSE represents the most modern equipment available and it meets or exceeds the requirements of all the test standards used. Test frequencies and the number of test specimen per sample are established based on statistical analysis and complexity of procedures.

B. Other Testing Capabilities

In addition to routine testing, GSE's laboratories are equipped to perform a wide variety of other tests as required for unusual requests or product development. Further, although the GSE quality assurance laboratories are fully equipped and able to perform most routinely specified tests in the industry, there are some tests that are more economically performed by a dedicated testing facility. GSE believes requirements for such testing should be carefully considered and defined in terms of specific design requirements if they are found to be necessary.

9.0 MATERIAL QUALITY ASSURANCE

GSE has established strict specifications for all raw materials and finished products. Test results must fall within the acceptable limits of GSE and customer's specifications.

A. Raw Material

GSE uses two types of raw materials in the manufacture of geonet products: natural resin and masterbatch. Natural resin is the base material that is used to make a geonet. It contains stabilizers to prevent degradation from occurring during and after extrusion. Masterbatch is the term referring to the concentrated carbon black material blended with the natural resin to produce the finished product. The natural resin and masterbatch are blended at the appropriate ratio at the manufacturing stage. The masterbatch can contain other additives depending upon the geonet product to be produced. GSE verifies the properties of each lot of raw material prior to their utilization. When natural resin is received, samples are taken and subjected to the tests as outlined in Appendix A. All

test data are entered into the computer database and checked for accuracy, consistency and compliance with GSE's specifications. The material is not accepted unless all standard test requirements are met and the GSE's test values meet the requirements set forth in the raw material specifications.

The GSE test results for each lot of resin are provided in a separate report upon request. Virgin resin is normally received in railcar lots. If resin is received by other transport and/or in other quantities, an equivalent suitable sampling procedure is provided (i.e. not less than one sample per shipment or one sample for each 50,000 lb, 23,000 kg).

In the production of geocomposite products, geotextiles laminated to one or both sides of the geonet can also be considered a raw material or component of the finished product. Quality assurance certificates are provided for all geotextile rolls bonded to the geocomposite.

B. Geonet Products

Geonet drainage products are produced with biplanar geometry. Please see GSE geonet data sheets for test methods, frequencies and specifications.

1. Sampling

   A one foot by roll width sample is cut for quality assurance testing from every tenth roll produced. An archive sample is cut from each tested roll. This sample is taken from a random location then labeled and stored for future reference. Test frequencies and the number of test specimen per sample are established based on statistical analysis of the available data and complexity of the test procedures.

2. Evaluation of Results

   All data are entered into a computer database for calculation and comparison to established order specifications. If materials do not meet the required GSE's standards and/or the customer's specifications, the manufacturing personnel will appropriately make the adjustments. Only products meeting GSE's standards and/or customer's specifications will be approved for shipment.

3. Reporting

   A quality assurance certificate is issued for every roll of finished product. This report identifies the standards on which the GSE approval is based along with the actual test results demonstrated by the material.

C. Geocomposite Products

Geocomposite products are produced by heat bonding a geotextile to one or both sides of a geonet product. Sampling evaluation of results and reporting practices are the same as for geonet products with the exception of testing for composite products. Please see GSE geocomposite data sheets for test methods, frequencies and specifications.

D. Third Party Conformance Sampling

Some specifications require independent quality assurance and/or conformance testing. GSE can provide assistance with the sampling of products by arranging for the conformance samples to be taken during production. By taking samples during production rather than on site or after production, the customer can be assured that the samples are clean and available for conformance testing in a timely manner.
GSE encourages customers to audit its manufacturing operations, to collect samples and conduct independent conformance testing prior to shipment of materials.

E. Product Shipping

It is GSE's policy to ship only products that have been tested and approved. All shipments are packaged according to industry's standard practices and/or customer's specifications. Only approved handling methods are used to move rolls into and out of shipping containers, please see the GSE Installation Quality Assurance Manual for more details.

Appendix A: Minimum Testing Frequencies for GSE Raw Materials

Property	Test Metod[1]	Natural Resin
Density	ASTM D 1505	once per resin lot
Melt Flow Index	ASTM D 1238 (190/2.16)	once per resin lot
Carbon Black Content	ASTM D 1603*/4218	N/A
Carbon Black Dispersion	ASTM D 5596	N/A

Notes:

- GSE utilizes test equipment and procedures that enable effective and economical confirmation that the product will conform to specifications based on the noted procedures. Some test procedures have been modified for application to geosynthetics. All procedures and values are subject to change without prior notification.
- Refer to GSE's ISO 9000 quality manual for raw material requirements for individual products.
- *Modified.

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Our commitment to innovation, our focus on quality and our industry expertise allow us the flexibility to collaborate with our clients to develop a custom, purpose-fit solution.

For more information on this product and others, please visit us at GSEworld.com, call 800.435.2008 or contact your local sales office.

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GEONET & GEOCOMPOSITE PRODUCTS
INSTALLATION QUALITY ASSURANCE MANUAL

Contents

1.0 INTRODUCTION

This manual provides an overview of the GSE Installation Quality Assurance procedures consistent with industry accepted practices to ensure that the geonet and geocomposite products installed will best perform for its intended purpose. In addition, all installation work will be performed in strict accordance per the customer's specifications. Please read the procedures below completely before you begin. If you need further clarification, contact the GSE Engineering Support Staff for assistance. Remember safety first and use safe practices always on every project.

2.0 ROLL PACKAGING

GSE geocomposite rolls shall be shipped from the factory in an opaque protective covering to prevent damage and UV degradation. However, GSE geonets do not need to be further protected from UV degradation during shipping or storage.

3.0 MATERIAL DELIVERY

A. Upon arrival on site, QA personnel will inventory all materials on-site.

B. Roll numbers of the geonet or geocomposite will be logged on the Inventory Check List (Appendix A) and cross-referenced with the Bill of Lading.

C. Copies of the Inventory Check List and signed Bill of Lading should be sent to GSE corporate headquarters while the on-site QA personnel retains the original copies.

D. Any visible damage to roll materials should be noted on the roll and Inventory Check List.

4.0 UNLOADING & STORAGE PROCEDURES

A. Rolls of material shall be unloaded with equipment that will not damage the geonet or geocomposite.

B. Fabric-straps, spreader bars, stinger bars, or other approved equipment shall be used for handling rolls of geonet and geocomposite.

C. Materials should be stored in a flat, dry and well drained area.

D. The surface shall be free of sharp rocks or other objects that could damage the materials.

5.0 SUBGRADE PREPARATION

The subgrade shall be free of sharp rocks or other objects that could otherwise cause damage to the materials.

6.0 DEPLOYMENT

Geonet and geocomposite shall be handled in a careful manner to ensure that it is not damaged in anyway.

A. On slopes, the material shall be anchored in the anchor trench and then rolled down the slope in such a manner as to continually keep the material under tension.

B. In the presence of wind, the leading edge of the material shall be weighted with temporary ballasting, such as sandbags until the final cover is placed.

C. Care shall be taken to assure that any underlying layers are not damaged during placement. Low ground pressure machines, such as ATV's to facilitate deployment over the geosynthetic layers is allowed. Low ground pressure machines are machines with a ground pressure less than 8 psi when carrying a driver weighing approximately 150 lbs.

D. Care shall be taken to avoid entrapment of stones, mud and other materials during placement operations.

7.0 OVERLAPS & SEAMS

A. The recommended geonet overlap in the machine direction is 3.0 in to 5.0 in. The recommended overlap in the transverse direction is 6.0 in to 12.0 in.

B. On slopes the ends of the materials shall be shingled down in the direction of the slope.

C. A plastic cable tie should be placed once per every five linear feet in the machine direction and once per every linear foot in the transverse direction.

D. f the product is a geocomposite, the geotextile on the bottom shall be overlapped and the geotextile on top shall be overlapped, sewn or heat bonded. The exact seaming method or overlap is typically specified in project construction documents.

8.0 COVER SOIL PLACEMENT

A. Prior to placement of cover soil, a Certificate of Acceptance (Appendix B) must be signed by a responsible party and an installer's representative.

B. Any cover material, such as soil, that is placed over the drainage material shall be placed with care to assure the material is not damaged.

C. Care shall be taken to minimize any movement of the geonet or geocomposite and to assure that no tensile stress is induced in the material.

D. Cover soils deployed over the geonet or geocomposite should be free of all sharp objects, sharp rocks and sticks.

E. Wide track equipment should be used to distribute cover soil over the geocomposite.

F. A minimum of 12.0 in of cover soil is required to separate the equipment from the geocomposite to prevent damage.

Geocomposite Drainage Layer Manufacturers Quality Control Testing

Roll Allocation List

Sales Order SO-085609
Customer Name Chenango Contracting
Project Name Chenango/Iron Horse LF

Serial number	Item Number	Resin Lot	Top	Bottom	Manufacturing date	Length
131557033	FT2-350E-08-08-E-00	18H1331	2025751721	2025751717	11/7/2018	150.00
131557034	FT2-350E-08-08-E-00	18H1331	2025751722	2025751717	11/7/2018	150.00
131557035	FT2-350E-08-08-E-00	18H1331	2025751722	2025751717	11/7/2018	150.00
131557036	FT2-350E-08-08-E-00	18H1331	2025751722	2025751717	11/7/2018	150.00
131557037	FT2-350E-08-08-E-00	18H1331	2025751722	2025751717	11/7/2018	150.00
131557038	FT2-350E-08-08-E-00	18H1331	2025751722	2025751717	11/7/2018	150.00
131557039	FT2-350E-08-08-E-00	18H1331	2025751722	2025751717	11/7/2018	150.00
131557040	FT2-350E-08-08-E-00	18H1331	2025751722	2025751717	11/7/2018	150.00
131557041	FT2-350E-08-08-E-00	18H1331	2025751722	2025751717	11/7/2018	150.00
131557042	FT2-350E-08-08-E-00	18H1331	2025751722	2025751723	11/7/2018	150.00
131557043	FT2-350E-08-08-E-00	18H1331	2025751722	2025751723	11/7/2018	150.00
131557044	FT2-350E-08-08-E-00	18H1331	2025751729	2025751723	11/7/2018	150.00
131557045	FT2-350E-08-08-E-00	18H1331	2025751729	2025751723	11/7/2018	150.00
131557046	FT2-350E-08-08-E-00	18H1331	2025751729	2025751723	11/7/2018	150.00
131557047	FT2-350E-08-08-E-00	18H1331	2025751729	2025751723	11/7/2018	150.00
131557048	FT2-350E-08-08-E-00	18H1331	2025751729	2025751723	11/7/2018	150.00
131557049	FT2-350E-08-08-E-00	18H1331	2025751729	2025751723	11/7/2018	150.00
131557050	FT2-350E-08-08-E-00	18H1331	2025751729	2025751723	11/7/2018	150.00
131557051	FT2-350E-08-08-E-00	18H1331	2025751729	2025751723	11/7/2018	150.00
131557052	FT2-350E-08-08-E-00	18H1331	2025751729	2025751725	11/7/2018	150.00
131557053	FT2-350E-08-08-E-00	18H1331	2025751729	2025751725	11/7/2018	150.00
131557054	FT2-350E-08-08-E-00	18H1331	2025751726	2025751725	11/7/2018	150.00
131557055	FT2-350E-08-08-E-00	18H1331	2025751726	2025751725	11/7/2018	150.00
131557056	FT2-350E-08-08-E-00	18H1331	2025751726	2025751725	11/7/2018	150.00
131557057	FT2-350E-08-08-E-00	18H1331	2025751726	2025751725	11/8/2018	150.00
131557058	FT2-350E-08-08-E-00	18H1331	2025751726	2025751725	11/8/2018	150.00
131557059	FT2-350E-08-08-E-00	18H1331	2025751726	2025751725	11/8/2018	150.00
131557060	FT2-350E-08-08-E-00	18H1331	2025751726	2025751725	11/8/2018	150.00
131557061	FT2-350E-08-08-E-00	18H1331	2025751726	2025757517	11/8/2018	150.00
131557062	FT2-350E-08-08-E-00	18H1331	2025751726	2025757517	11/8/2018	150.00
131557063	FT2-350E-08-08-E-00	18H1331	2025751750	2025757517	11/8/2018	150.00
131557064	FT2-350E-08-08-E-00	18H1331	2025751750	2025757517	11/8/2018	150.00
131557065	FT2-350E-08-08-E-00	18H1331	2025751750	2025757517	11/8/2018	150.00
131557066	FT2-350E-08-08-E-00	18H1331	2025751750	2025757517	11/8/2018	150.00
131557067	FT2-350E-08-08-E-00	18H1331	2025751750	2025757517	11/8/2018	150.00
131557068	FT2-350E-08-08-E-00	18H1331	2025751750	2025757517	11/8/2018	150.00
131557069	FT2-350E-08-08-E-00	18H1331	2025751750	2025757517	11/8/2018	150.00
131557070	FT2-350E-08-08-E-00	18H1331	2025751750	2025757517	11/8/2018	150.00
131557071	FT2-350E-08-08-E-00	18H1331	2025751750	2025757517	11/8/2018	150.00
131557072	FT2-350E-08-08-E-00	18H1331	2025751750	2025751719	11/8/2018	150.00
131557073	FT2-350E-08-08-E-00	18H1331	2025751738	2025751719	11/8/2018	150.00
131557074	FT2-350E-08-08-E-00	18H1331	2025751738	2025751719	11/8/2018	150.00
131557075	FT2-350E-08-08-E-00	18H1331	2025751738	2025751719	11/8/2018	150.00
131557076	FT2-350E-08-08-E-00	18H1331	2025751738	2025751719	11/8/2018	150.00
131557077	FT2-350E-08-08-E-00	18H1331	2025751738	2025751719	11/8/2018	150.00
131557078	FT2-350E-08-08-E-00	18H1331	2025751738	2025751719	11/8/2018	150.00
131557079	FT2-350E-08-08-E-00	18H1331	2025751738	2025751719	11/8/2018	150.00
131557080	FT2-350E-08-08-E-00	18H1331	2025751738	2025751719	11/8/2018	150.00
131557081	FT2-350E-08-08-E-00	18H1331	2025751738	2025757527	11/8/2018	150.00
131557082	FT2-350E-08-08-E-00	18H1331	2025751738	2025757527	11/8/2018	150.00
131557083	FT2-350E-08-08-E-00	18H1331	2025757514	2025757527	11/8/2018	150.00
131557084	FT2-350E-08-08-E-00	18H1331	2025757514	2025757527	11/8/2018	150.00
131557085	FT2-350E-08-08-E-00	18H1331	2025757514	2025757527	11/8/2018	150.00
131557086	FT2-350E-08-08-E-00	18H1331	2025757514	2025757527	11/8/2018	150.00
131557087	FT2-350E-08-08-E-00	18H1331	2025757514	2025757527	11/8/2018	150.00
131557089	FT2-350E-08-08-E-00	18H1331	2025757514	2025757527	11/8/2018	150.00
131557090	FT2-350E-08-08-E-00	18H1331	2025757514	2025757527	11/8/2018	150.00
131557091	FT2-350E-08-08-E-00	18H1331	2025757514	2025757527	11/8/2018	150.00
131557092	FT2-350E-08-08-E-00	18H1331	2025757514	2025751731	11/8/2018	150.00
131557093	FT2-350E-08-08-E-00	18H1331	2025751724	2025751731	11/8/2018	150.00
131557094	FT2-350E-08-08-E-00	18H1331	2025751724	2025751731	11/8/2018	150.00
131557095	FT2-350E-08-08-E-00	18H1331	2025751724	2025751731	11/8/2018	150.00
131557096	FT2-350E-08-08-E-00	18H1331	2025751724	2025751731	11/8/2018	150.00
131557097	FT2-350E-08-08-E-00	18H1331	2025751724	2025751731	11/8/2018	150.00
131557098	FT2-350E-08-08-E-00	18H1331	2025751724	2025751731	11/8/2018	150.00
131557099	FT2-350E-08-08-E-00	18H1331	2025751724	2025751731	11/8/2018	150.00
131557100	FT2-350E-08-08-E-00	18H1331	2025751724	2025751733	11/8/2018	150.00
131557101	FT2-350E-08-08-E-00	18H1331	2025757522	2025751733	11/8/2018	150.00

Roll Allocation List

Sales Order SO-085609
Customer Name Chenango Contracting
Project Name Chenango/Iron Horse LF

Serial number	Item Number	Resin Lot	Top	Bottom	Manufacturing date	Length
131557102	FT2-350E-08-08-E-00	18H1331	2025757522	2025751733	11/8/2018	150.00
131557103	FT2-350E-08-08-E-00	18H1331	2025757522	2025751733	11/8/2018	150.00
131557104	FT2-350E-08-08-E-00	18H1331	2025757522	2025751733	11/8/2018	150.00
131557105	FT2-350E-08-08-E-00	18H1331	2025757522	2025751733	11/8/2018	150.00
131557106	FT2-350E-08-08-E-00	18H1331	2025757522	2025751733	11/8/2018	150.00
131557107	FT2-350E-08-08-E-00	18H1331	2025757522	2025751733	11/8/2018	150.00
131557108	FT2-350E-08-08-E-00	18H1331	2025757522	2025751733	11/8/2018	150.00
131557109	FT2-350E-08-08-E-00	18H1331	2025757522	2025751733	11/8/2018	150.00
131557110	FT2-350E-08-08-E-00	18H1331	2025757522	2025751665	11/8/2018	150.00
131557111	FT2-350E-08-08-E-00	18H1331	2025751668	2025751665	11/8/2018	150.00
131557112	FT2-350E-08-08-E-00	18H1331	2025751668	2025751665	11/8/2018	150.00

GSE Environmental, LLC

ROLL TEST DATA REPORT

GSE QC APPROVED

Report Date: Nov/13/2018

Sales Order No.	Customer Name	Project Location	Product Name	BOL Number
SO-085609	Chenango Contracting	North Billerica MA US	FT2-350E-08-08-E-00	

Roll Number	Geonet Thickness ASTM D5199 (mils)	Tensile Strength ASTM D7179 (ppi)	Density ASTM D1505 (g/cc)	Carbon Black Content ASTM D4218 (%)	Ply Adhesion Average ASTM D7005 (ppi) Side A	Ply Adhesion Average ASTM D7005 (ppi) Side B
131557033	348	134	0.954	2.5	2.0	1.8
131557034	348	121	0.956	2.4	1.6	1.7
131557035	348	121	0.956	2.4	1.6	1.7
131557036	348	121	0.956	2.4	1.6	1.7
131557037	348	121	0.956	2.4	1.6	1.7
131557038	348	121	0.956	2.4	1.6	1.7
131557039	348	121	0.956	2.4	1.6	1.7
131557040	348	121	0.956	2.4	1.6	1.7
131557041	348	121	0.956	2.4	1.6	1.7
131557042	348	121	0.956	2.4	1.6	1.7
131557043	348	121	0.956	2.4	1.6	1.7
131557044	348	121	0.956	2.4	1.6	1.7
131557045	348	121	0.956	2.4	1.6	1.7
131557046	348	121	0.956	2.4	1.6	1.7
131557047	348	121	0.956	2.4	1.6	1.7
131557048	348	121	0.956	2.4	1.6	1.7
131557049	348	121	0.956	2.4	1.6	1.7
131557050	348	121	0.956	2.4	1.6	1.7
131557051	348	121	0.956	2.4	1.6	1.7
131557052	348	121	0.956	2.4	1.6	1.7
131557053	348	121	0.956	2.4	1.6	1.7
131557054	348	121	0.956	2.4	1.6	1.7
131557055	348	121	0.956	2.4	1.6	1.7
131557056	346	129	0.961	2.5	1.9	3.0
131557057	346	129	0.961	2.5	1.9	3.0
131557058	346	129	0.961	2.5	1.9	3.0
131557059	346	129	0.961	2.5	1.9	3.0
131557060	346	129	0.961	2.5	1.9	3.0
131557061	346	129	0.961	2.5	1.9	3.0
131557062	346	129	0.961	2.5	1.9	3.0
131557063	346	129	0.961	2.5	1.9	3.0
131557064	346	129	0.961	2.5	1.9	3.0
131557065	346	129	0.961	2.5	1.9	3.0
131557066	346	129	0.961	2.5	1.9	3.0

GSE Environmental, LLC

ROLL TEST DATA REPORT

GSE QC APPROVED

Report Date: Nov/13/2018

Sales Order No.	Customer Name	Project Location	Product Name	BOL Number
SO-085609	Chenango Contracting	North Billerica MA US	FT2-350E-08-08-E-00	

Roll Number	Geonet Thickness ASTM D5199 (mils)	Tensile Strength ASTM D7179 (ppi)	Density ASTM D1505 (g/cc)	Carbon Black Content ASTM D4218 (%)	Ply Adhesion Average ASTM D7005 (ppi) Side A	Ply Adhesion Average ASTM D7005 (ppi) Side B
131557067	346	129	0.961	2.5	1.9	3.0
131557068	346	129	0.961	2.5	1.9	3.0
131557069	346	129	0.961	2.5	1.9	3.0
131557070	346	129	0.961	2.5	1.9	3.0
131557071	346	129	0.961	2.5	1.9	3.0
131557072	346	129	0.961	2.5	1.9	3.0
131557073	346	129	0.961	2.5	1.9	3.0
131557074	346	129	0.961	2.5	1.9	3.0
131557075	346	129	0.961	2.5	1.9	3.0
131557076	346	129	0.961	2.5	1.9	3.0
131557077	346	129	0.961	2.5	1.9	3.0
131557078	342	125	0.958	2.5	1.8	3.3
131557079	342	125	0.958	2.5	1.8	3.3
131557080	342	125	0.958	2.5	1.8	3.3
131557081	342	125	0.958	2.5	1.8	3.3
131557082	342	125	0.958	2.5	1.8	3.3
131557083	342	125	0.958	2.5	1.8	3.3
131557084	342	125	0.958	2.5	1.8	3.3
131557085	342	125	0.958	2.5	1.8	3.3
131557086	342	125	0.958	2.5	1.8	3.3
131557087	342	125	0.958	2.5	1.8	3.3
131557089	342	125	0.958	2.5	1.8	3.3
131557090	342	125	0.958	2.5	1.8	3.3
131557091	342	125	0.958	2.5	1.8	3.3
131557092	342	125	0.958	2.5	1.8	3.3
131557093	342	125	0.958	2.5	1.8	3.3
131557094	342	125	0.958	2.5	1.8	3.3
131557095	342	125	0.958	2.5	1.8	3.3
131557096	342	125	0.958	2.5	1.8	3.3
131557097	342	125	0.958	2.5	1.8	3.3
131557098	342	125	0.958	2.5	1.8	3.3
131557099	342	125	0.958	2.5	1.8	3.3
131557100	342	131	0.960	2.6	2.6	4.1
131557101	342	131	0.960	2.6	2.6	4.1

GSE Environmental, LLC

ROLL TEST DATA REPORT

Report Date: Nov/13/2018

Sales Order No.	Customer Name	Project Location	Product Name	BOL Number
SO-085609	Chenango Contracting	North Billerica MA US	FT2-350E-08-08-E-00	

Roll Number	Geonet Thickness ASTM D5199 (mils)	Tensile Strength ASTM D7179 (ppi)	Density ASTM D1505 (g/cc)	Carbon Black Content ASTM D4218 (%)	Ply Adhesion Average ASTM D7005 (ppi) Side A	Ply Adhesion Average ASTM D7005 (ppi) Side B
131557102	342	131	0.960	2.6	2.6	4.1
131557103	342	131	0.960	2.6	2.6	4.1
131557104	342	131	0.960	2.6	2.6	4.1
131557105	342	131	0.960	2.6	2.6	4.1
131557106	342	131	0.960	2.6	2.6	4.1
131557107	342	131	0.960	2.6	2.6	4.1
131557108	342	131	0.960	2.6	2.6	4.1
131557109	342	131	0.960	2.6	2.6	4.1
131557110	342	131	0.960	2.6	2.6	4.1
131557111	342	131	0.960	2.6	2.6	4.1
131557112	342	131	0.960	2.6	2.6	4.1

Laboratory Manager

GSE Lining Technology, LLC.

ROLL TEST DATA REPORT

Report Date: Nov/13/2018

Sales Order No.	Customer Name	Project Location	Product Name	BOL Number
SO-085609	Chenango Contracting	North Billerica MA US	FBR-080E-EBC-E-005	

GSE QC APPROVED

ROLL #	ASTM D4751 A0S (mm)	ASTM D6241 CBR PUNCTURE (lbs)	Mass per Unit Area ASTM D5261 (oz/yd²)	ASTM D4632 Elongation @ Break (%) MD	ASTM D4632 Grab Strength (lbs) MD	ASTM D4533 Trapezoidoal Tear (lbs) MD	ASTM D4491 Permittivity (sec-1)	ASTM D4833 Puncture Resistance (lbs)	Water Flow D4491 gpm/ft2	ASTM D4632 Elongation @ Break (%) TD	ASTM D4632 Grab Strength (lbs) TD	ASTM D4533 Trapezoidoal Tear (lbs) TD
2025751665	0.180	714	9.4	83	307	100	1.8	165	100	90	387	137
2025751668	0.180	757	9.1	81	288	104	1.8	156	132	89	350	121
2025751717	0.180	784	8.4	82	296	105	2.0	157	147	90	337	118
2025751719	0.180	799	8.2	76	290	98	1.5	143	112	86	325	113
2025751721	0.180	799	8.2	76	290	98	1.5	143	112	86	325	113
2025751722	0.180	856	9.3	78	294	106	1.5	159	114	83	332	138
2025751723	0.180	856	9.3	78	294	106	1.5	159	114	83	332	138
2025751724	0.180	856	9.3	78	294	106	1.5	159	114	83	332	138
2025751725	0.180	856	9.3	78	294	106	1.5	159	114	83	332	138
2025751726	0.180	811	9.3	87	298	104	1.6	163	116	95	356	120
2025751729	0.180	811	9.3	87	298	104	1.6	163	116	95	356	120
2025751731	0.180	850	8.9	80	292	115	2.1	158	153	95	380	132
2025751733	0.180	850	8.9	80	292	115	2.1	158	153	95	380	132
2025751738	0.180	802	9.1	83	292	107	2.1	161	153	95	368	136
2025751750	0.180	848	9.4	78	302	108	2.0	189	144	88	362	127
2025757514	0.180	788	8.4	77	250	96	1.8	141	130	95	311	110
2025757517	0.180	950	9.6	81	309	128	1.8	177	130	87	339	150
2025757522	0.180	808	8.6	79	291	118	1.8	168	132	88	332	136
2025757527	0.180	870	9.3	77	292	114	1.8	164	133	90	353	138

Laboratory Manager: Thomas E. Harrelson

Formosa Plastics

FORMOSA PLASTICS CORPORATION, TEXAS
201 FORMOSA DRIVE
PO BOX 700
POINT COMFORT TX 77978
PHONE:(888)FPCUSA3

Certificate of Analysis

(CONFIDENTIAL)

CUSTOMER:GSE ENVIRONMENTAL LLC
1245 EASTLAND AVE
KINGSTREE SC 29556
PRODUCT :HB5502B
RAILCAR FPAX201220
CLEANING/INSPECTION NO: 201220082718

S/O NO : ET9A241
CUSTOMER PO : 03-513784
DATE SHIPPED: 9/18/18
LOT NO : 18H1331
WEIGHT (LB) : 198,350.00
CUSTID:FT03112 SPIDE3

TEST ITEM	REFERENCE METHOD	TEST VALUE
Melt Index,g/10min	ASTM D1238	.33
Density, g/cm3	ASTM D1505	.9540

Linda Kao

QC SUPERVISOR: LINDA KAO

GSE ENVIRONMENTAL™ GSE Environmental, LLC.

Transmissivity Report

ASTM D4716

Roll No. 131557033

ROLL IDENTIFICATION

Roll Number	131557033
Product Name	FT2-350E-08-08-E-00
Production Date	11/7/2018

CUSTOMER INFORMATION

Order Number	85609
Customer Name	Chenango Contracting
Project Name	Chenango/Iron Horse LF
Location	North Billerica MA US

Pressure (psf)	*Gradient*	*Net/Composite*	*Transmissivity Results* (m^2/sec)	(gal/min/ft)	*Seat Time (min)*	*Boundary*
1,000	0.10	Composite	5.77E-03	27.87	6000	soil/geocomposite/geomembrane
1,000	0.20	Composite	4.25E-03	20.53	6000	soil/geocomposite/geomembrane
1,000	0.35	Composite	3.39E-03	16.38	6000	soil/geocomposite/geomembrane
1,000	0.50	Composite	2.90E-03	14.01	6000	soil/geocomposite/geomembrane

GSE QC APPROVED

GSE Roll Allocation

Order SO-085609

Customer Chenango Contracting

Project Name Iron Horse LF

GeoTesting
Express
3ft x roll width, 2 samples from the same roll

Roll#	Resin Lot	Product Code	Mfg Date	Length	Sent
131557033	18H1331	FT2-350E-08-08-E-00	11/7/2018	150	9-Nov
131557034	18H1331	FT2-350E-08-08-E-00	11/7/2018	150	
131557035	18H1331	FT2-350E-08-08-E-00	11/7/2018	150	
131557036	18H1331	FT2-350E-08-08-E-00	11/7/2018	150	
131557037	18H1331	FT2-350E-08-08-E-00	11/7/2018	150	
131557038	18H1331	FT2-350E-08-08-E-00	11/7/2018	150	
131557039	18H1331	FT2-350E-08-08-E-00	11/7/2018	150	
131557040	18H1331	FT2-350E-08-08-E-00	11/7/2018	150	
131557041	18H1331	FT2-350E-08-08-E-00	11/7/2018	150	
131557042	18H1331	FT2-350E-08-08-E-00	11/7/2018	150	
131557043	18H1331	FT2-350E-08-08-E-00	11/7/2018	150	
131557044	18H1331	FT2-350E-08-08-E-00	11/7/2018	150	
131557045	18H1331	FT2-350E-08-08-E-00	11/7/2018	150	
131557046	18H1331	FT2-350E-08-08-E-00	11/7/2018	150	
131557047	18H1331	FT2-350E-08-08-E-00	11/7/2018	150	
131557048	18H1331	FT2-350E-08-08-E-00	11/7/2018	150	
131557049	18H1331	FT2-350E-08-08-E-00	11/7/2018	150	
131557050	18H1331	FT2-350E-08-08-E-00	11/7/2018	150	
131557051	18H1331	FT2-350E-08-08-E-00	11/7/2018	150	
131557052	18H1331	FT2-350E-08-08-E-00	11/7/2018	150	
131557053	18H1331	FT2-350E-08-08-E-00	11/7/2018	150	
131557054	18H1331	FT2-350E-08-08-E-00	11/7/2018	150	
131557055	18H1331	FT2-350E-08-08-E-00	11/7/2018	150	
131557056	18H1331	FT2-350E-08-08-E-00	11/7/2018	150	
131557057	18H1331	FT2-350E-08-08-E-00	11/8/2018	150	
131557058	18H1331	FT2-350E-08-08-E-00	11/8/2018	150	
131557059	18H1331	FT2-350E-08-08-E-00	11/8/2018	150	
131557060	18H1331	FT2-350E-08-08-E-00	11/8/2018	150	
131557061	18H1331	FT2-350E-08-08-E-00	11/8/2018	150	
131557062	18H1331	FT2-350E-08-08-E-00	11/8/2018	150	
131557063	18H1331	FT2-350E-08-08-E-00	11/8/2018	150	
131557064	18H1331	FT2-350E-08-08-E-00	11/8/2018	150	
131557065	18H1331	FT2-350E-08-08-E-00	11/8/2018	150	
131557066	18H1331	FT2-350E-08-08-E-00	11/8/2018	150	
131557067	18H1331	FT2-350E-08-08-E-00	11/8/2018	150	
131557068	18H1331	FT2-350E-08-08-E-00	11/8/2018	150	
131557069	18H1331	FT2-350E-08-08-E-00	11/8/2018	150	
131557070	18H1331	FT2-350E-08-08-E-00	11/8/2018	150	
131557071	18H1331	FT2-350E-08-08-E-00	11/8/2018	150	
131557072	18H1331	FT2-350E-08-08-E-00	11/8/2018	150	
131557073	18H1331	FT2-350E-08-08-E-00	11/8/2018	150	
131557074	18H1331	FT2-350E-08-08-E-00	11/8/2018	150	
131557075	18H1331	FT2-350E-08-08-E-00	11/8/2018	150	
131557076	18H1331	FT2-350E-08-08-E-00	11/8/2018	150	
131557077	18H1331	FT2-350E-08-08-E-00	11/8/2018	150	
131557078	18H1331	FT2-350E-08-08-E-00	11/8/2018	150	
131557079	18H1331	FT2-350E-08-08-E-00	11/8/2018	150	
131557080	18H1331	FT2-350E-08-08-E-00	11/8/2018	150	

131557081	18H1331	FT2-350E-08-08-E-00	11/8/2018	150
131557082	18H1331	FT2-350E-08-08-E-00	11/8/2018	150
131557083	18H1331	FT2-350E-08-08-E-00	11/8/2018	150
131557084	18H1331	FT2-350E-08-08-E-00	11/8/2018	150
131557085	18H1331	FT2-350E-08-08-E-00	11/8/2018	150
131557086	18H1331	FT2-350E-08-08-E-00	11/8/2018	150
131557087	18H1331	FT2-350E-08-08-E-00	11/8/2018	150
131557089	18H1331	FT2-350E-08-08-E-00	11/8/2018	150
131557090	18H1331	FT2-350E-08-08-E-00	11/8/2018	150
131557091	18H1331	FT2-350E-08-08-E-00	11/8/2018	150
131557092	18H1331	FT2-350E-08-08-E-00	11/8/2018	150
131557093	18H1331	FT2-350E-08-08-E-00	11/8/2018	150
131557094	18H1331	FT2-350E-08-08-E-00	11/8/2018	150
131557095	18H1331	FT2-350E-08-08-E-00	11/8/2018	150
131557096	18H1331	FT2-350E-08-08-E-00	11/8/2018	150
131557097	18H1331	FT2-350E-08-08-E-00	11/8/2018	150
131557098	18H1331	FT2-350E-08-08-E-00	11/8/2018	150
131557099	18H1331	FT2-350E-08-08-E-00	11/8/2018	150
131557100	18H1331	FT2-350E-08-08-E-00	11/8/2018	150
131557101	18H1331	FT2-350E-08-08-E-00	11/8/2018	150
131557102	18H1331	FT2-350E-08-08-E-00	11/8/2018	150
131557103	18H1331	FT2-350E-08-08-E-00	11/8/2018	150
131557104	18H1331	FT2-350E-08-08-E-00	11/8/2018	150
131557105	18H1331	FT2-350E-08-08-E-00	11/8/2018	150
131557106	18H1331	FT2-350E-08-08-E-00	11/8/2018	150
131557107	18H1331	FT2-350E-08-08-E-00	11/8/2018	150
131557108	18H1331	FT2-350E-08-08-E-00	11/8/2018	150
131557109	18H1331	FT2-350E-08-08-E-00	11/8/2018	150
131557110	18H1331	FT2-350E-08-08-E-00	11/8/2018	150
131557111	18H1331	FT2-350E-08-08-E-00	11/8/2018	150
131557112	18H1331	FT2-350E-08-08-E-00	11/8/2018	150

GSE ENVIRONMENTAL™

GSE Environmental, LLC.

Transmissivity Report

ASTM D4716

Test Conditions		*CUSTOMER INFORMATION*	
Pressure	***1,000 psf***	***Order Number***	85609
Seat Time	***6000 minutes***	***Customer Name***	Chenango Contracting
Boundary	***soil/geocomposite/geomembrane***	***Project Name***	Chenango/Iron Horse LF
		Location	North Billerica MA US

Roll#	Transmissivity (m^2/sec) @ Gradient 0.10	Transmissivity (m^2/sec) @ Gradient 0.20	Transmissivity (m^2/sec) @ Gradient 0.35	Transmissivity (m^2/sec @ Gradient 0.50
131557033	5.77E-03	4.25E-03	3.39E-03	2.90E-03
131557034	5.77E-03	4.25E-03	3.39E-03	2.90E-03
131557035	5.77E-03	4.25E-03	3.39E-03	2.90E-03
131557036	5.77E-03	4.25E-03	3.39E-03	2.90E-03
131557037	5.77E-03	4.25E-03	3.39E-03	2.90E-03
131557038	5.77E-03	4.25E-03	3.39E-03	2.90E-03
131557039	5.77E-03	4.25E-03	3.39E-03	2.90E-03
131557040	5.77E-03	4.25E-03	3.39E-03	2.90E-03
131557041	5.77E-03	4.25E-03	3.39E-03	2.90E-03
131557042	5.77E-03	4.25E-03	3.39E-03	2.90E-03
131557043	5.77E-03	4.25E-03	3.39E-03	2.90E-03
131557044	5.77E-03	4.25E-03	3.39E-03	2.90E-03
131557045	5.77E-03	4.25E-03	3.39E-03	2.90E-03
131557046	5.77E-03	4.25E-03	3.39E-03	2.90E-03
131557047	5.77E-03	4.25E-03	3.39E-03	2.90E-03
131557048	5.77E-03	4.25E-03	3.39E-03	2.90E-03
131557049	5.77E-03	4.25E-03	3.39E-03	2.90E-03
131557050	5.77E-03	4.25E-03	3.39E-03	2.90E-03
131557051	5.77E-03	4.25E-03	3.39E-03	2.90E-03
131557052	5.77E-03	4.25E-03	3.39E-03	2.90E-03
131557053	5.77E-03	4.25E-03	3.39E-03	2.90E-03
131557054	5.77E-03	4.25E-03	3.39E-03	2.90E-03
131557055	5.77E-03	4.25E-03	3.39E-03	2.90E-03
131557056	5.77E-03	4.25E-03	3.39E-03	2.90E-03
131557057	5.77E-03	4.25E-03	3.39E-03	2.90E-03
131557058	5.77E-03	4.25E-03	3.39E-03	2.90E-03
131557059	5.77E-03	4.25E-03	3.39E-03	2.90E-03
131557060	5.77E-03	4.25E-03	3.39E-03	2.90E-03
131557061	5.77E-03	4.25E-03	3.39E-03	2.90E-03
131557062	5.77E-03	4.25E-03	3.39E-03	2.90E-03
131557063	5.77E-03	4.25E-03	3.39E-03	2.90E-03

131557064	5.77E-03	4.25E-03	3.39E-03	2.90E-03
131557065	5.77E-03	4.25E-03	3.39E-03	2.90E-03
131557066	5.77E-03	4.25E-03	3.39E-03	2.90E-03
131557067	5.77E-03	4.25E-03	3.39E-03	2.90E-03
131557068	5.77E-03	4.25E-03	3.39E-03	2.90E-03
131557069	5.77E-03	4.25E-03	3.39E-03	2.90E-03
131557070	5.77E-03	4.25E-03	3.39E-03	2.90E-03
131557071	5.77E-03	4.25E-03	3.39E-03	2.90E-03
131557072	5.77E-03	4.25E-03	3.39E-03	2.90E-03
131557073	5.77E-03	4.25E-03	3.39E-03	2.90E-03
131557074	5.77E-03	4.25E-03	3.39E-03	2.90E-03
131557075	5.77E-03	4.25E-03	3.39E-03	2.90E-03
131557076	5.77E-03	4.25E-03	3.39E-03	2.90E-03
131557077	5.77E-03	4.25E-03	3.39E-03	2.90E-03
131557078	5.77E-03	4.25E-03	3.39E-03	2.90E-03
131557079	5.77E-03	4.25E-03	3.39E-03	2.90E-03
131557080	5.77E-03	4.25E-03	3.39E-03	2.90E-03
131557081	5.77E-03	4.25E-03	3.39E-03	2.90E-03
131557082	5.77E-03	4.25E-03	3.39E-03	2.90E-03
131557083	5.77E-03	4.25E-03	3.39E-03	2.90E-03
131557084	5.77E-03	4.25E-03	3.39E-03	2.90E-03
131557085	5.77E-03	4.25E-03	3.39E-03	2.90E-03
131557086	5.77E-03	4.25E-03	3.39E-03	2.90E-03
131557087	5.77E-03	4.25E-03	3.39E-03	2.90E-03
131557089	5.77E-03	4.25E-03	3.39E-03	2.90E-03
131557090	5.77E-03	4.25E-03	3.39E-03	2.90E-03
131557091	5.77E-03	4.25E-03	3.39E-03	2.90E-03
131557092	5.77E-03	4.25E-03	3.39E-03	2.90E-03
131557093	5.77E-03	4.25E-03	3.39E-03	2.90E-03
131557094	5.77E-03	4.25E-03	3.39E-03	2.90E-03
131557095	5.77E-03	4.25E-03	3.39E-03	2.90E-03
131557096	5.77E-03	4.25E-03	3.39E-03	2.90E-03
131557097	5.77E-03	4.25E-03	3.39E-03	2.90E-03
131557098	5.77E-03	4.25E-03	3.39E-03	2.90E-03
131557099	5.77E-03	4.25E-03	3.39E-03	2.90E-03
131557100	5.77E-03	4.25E-03	3.39E-03	2.90E-03
131557101	5.77E-03	4.25E-03	3.39E-03	2.90E-03
131557102	5.77E-03	4.25E-03	3.39E-03	2.90E-03
131557103	5.77E-03	4.25E-03	3.39E-03	2.90E-03
131557104	5.77E-03	4.25E-03	3.39E-03	2.90E-03
131557105	5.77E-03	4.25E-03	3.39E-03	2.90E-03
131557106	5.77E-03	4.25E-03	3.39E-03	2.90E-03
131557107	5.77E-03	4.25E-03	3.39E-03	2.90E-03
131557108	5.77E-03	4.25E-03	3.39E-03	2.90E-03
131557109	5.77E-03	4.25E-03	3.39E-03	2.90E-03
131557110	5.77E-03	4.25E-03	3.39E-03	2.90E-03
131557111	5.77E-03	4.25E-03	3.39E-03	2.90E-03
131557112	5.77E-03	4.25E-03	3.39E-03	2.90E-03

Client:	Chenango Contracting, Inc.		
Project:	Iron Horse Park		
Project Location:	Billerica, MA		
GTX Project No.:	309168	Tested By:	dln
Test Date:	11/30/18	Checked By:	bfs
Sample ID:	Roll #131557033 (FT2-350E-08-08-E-00, FabriNet TRXH)		
Description:	Black, 350 mil GSE hi-flow double-sided nonwoven geocomposite		

Hydraulic Transmissivity - ASTM D4716

Specimen Length, in:	12
Specimen Width, in:	12
Boundary Conditions	(top to bottom): steel plate / soil / geocomposite / geomembrane / steel plate
Direction of Flow:	Machine Direction
Effluent Water Temperature, °C:	17.7

Normal Compressive Stress, psf	Seating Time, hours	Hydraulic Gradient	Transmissivity, m^2/sec	Unit Flow (See Note 1)	
				gal/min/ft	gal/hr/ft
1000	5	0.1	3.8E-03	1.7	105
1000	5	0.1	3.7E-03	1.7	104
1000	5	0.1	3.8E-03	1.7	104
		Average	3.8E-03	1.7	104
1000	10	0.1	3.5E-03	1.6	98
1000	10	0.1	3.5E-03	1.6	98
1000	10	0.1	3.5E-03	1.6	98
			3.5E-03	1.6	98
1000	24	0.1	3.4E-03	1.6	94
1000	24	0.1	3.4E-03	1.6	94
1000	24	0.1	3.4E-03	1.6	94
		Average	3.4E-03	1.6	94
1000	29	0.1	3.4E-03	1.5	92
1000	29	0.1	3.4E-03	1.5	93
1000	29	0.1	3.4E-03	1.5	93
		Average	3.4E-03	1.5	93
1000	48	0.1	3.2E-03	1.5	88
1000	48	0.1	3.2E-03	1.4	87
1000	48	0.1	3.2E-03	1.5	87
		Average	3.2E-03	1.5	87
1000	53	0.1	3.1E-03	1.4	85
1000	53	0.1	3.1E-03	1.4	86
1000	53	0.1	3.1E-03	1.4	85
		Average	3.1E-03	1.4	85
1000	72	0.1	3.0E-03	1.4	83
1000	72	0.1	3.0E-03	1.4	82
1000	72	0.1	3.0E-03	1.4	82
		Average	3.0E-03	1.4	82
1000	77	0.1	3.0E-03	1.4	81
1000	77	0.1	3.0E-03	1.4	81
1000	77	0.1	3.0E-03	1.4	81
		Average	3.0E-03	1.4	81
1000	100	0.1	2.9E-03	1.3	81
1000	100	0.1	2.9E-03	1.3	81
1000	100	0.1	3.0E-03	1.4	81
		Average	3.0E-03	1.3	81

Notes: (1) Flow rate calculated by measuring actual volume of flow during specific time interval.

Client:	Chenango Contracting, Inc.		
Project:	Iron Horse Park		
Project Location:	Billerica, MA		
GTX Project No.:	309168	Tested By:	dln
Test Date:	11/30/18	Checked By:	bfs
Sample ID:	Roll #131557033 (FT2-350E-08-08-E-00, FabriNet TRXH)		
Description:	Black, 350 mil GSE hi-flow double-sided nonwoven geocomposite		

Hydraulic Transmissivity - ASTM D4716

Specimen Length, in:	12
Specimen Width, in:	12
Boundary Conditions	(top to bottom): steel plate / soil / geocomposite / geomembrane / steel plate
Direction of Flow:	Machine Direction
Effluent Water Temperature, °C:	17.7

Normal Compressive Stress, psf	Seating Time, hours	Hydraulic Gradient	Transmissivity, m^2/sec	Unit Flow (See Note 1)	
				gal/min/ft	gal/hr/ft
1000	5	0.2	3.3E-03	3.0	181
1000	5	0.2	3.3E-03	3.0	181
1000	5	0.2	3.3E-03	3.0	182
		Average	3.3E-03	3.0	181
1000	10	0.2	2.8E-03	2.6	156
1000	10	0.2	2.8E-03	2.6	156
1000	10	0.2	2.8E-03	2.6	156
			2.8E-03	2.6	156
1000	24	0.2	2.6E-03	2.4	142
1000	24	0.2	2.6E-03	2.4	143
1000	24	0.2	2.6E-03	2.4	142
		Average	2.6E-03	2.4	142
1000	29	0.2	2.5E-03	2.3	140
1000	29	0.2	2.6E-03	2.3	140
1000	29	0.2	2.6E-03	2.3	140
		Average	2.6E-03	2.3	140
1000	48	0.2	2.5E-03	2.3	136
1000	48	0.2	2.5E-03	2.3	135
1000	48	0.2	2.5E-03	2.3	136
		Average	2.5E-03	2.3	136
1000	53	0.2	2.5E-03	2.2	135
1000	53	0.2	2.5E-03	2.2	134
1000	53	0.2	2.5E-03	2.2	134
		Average	2.5E-03	2.2	135
1000	72	0.2	2.3E-03	2.1	128
1000	72	0.2	2.4E-03	2.1	128
1000	72	0.2	2.3E-03	2.1	128
		Average	2.3E-03	2.1	128
1000	77	0.2	2.3E-03	2.1	127
1000	77	0.2	2.3E-03	2.1	127
1000	77	0.2	2.3E-03	2.1	127
		Average	2.3E-03	2.1	127
1000	100	0.2	2.3E-03	2.1	126
1000	100	0.2	2.3E-03	2.1	126
1000	100	0.2	2.3E-03	2.1	126
		Average	2.3E-03	2.1	126

Notes: (1) Flow rate calculated by measuring actual volume of flow during specific time interval.

Client:	Chenango Contracting, Inc.		
Project:	Iron Horse Park		
Project Location:	Billerica, MA		
GTX Project No.:	309168	Tested By:	dln
Test Date:	11/30/18	Checked By:	bfs
Sample ID:	Roll #131557033 (FT2-350E-08-08-E-00, FabriNet TRXH)		
Description:	Black, 350 mil GSE hi-flow double-sided nonwoven geocomposite		

Hydraulic Transmissivity - ASTM D4716

Specimen Length, in:	12
Specimen Width, in:	12
Boundary Conditions	(top to bottom): steel plate / soil / geocomposite / geomembrane / steel plate
Direction of Flow:	Machine Direction
Effluent Water Temperature, °C:	17.7

Normal Compressive Stress, psf	Seating Time, hours	Hydraulic Gradient	Transmissivity, m^2/sec	Unit Flow (See Note 1)	
				gal/min/ft	gal/hr/ft
1000	5	0.5	2.2E-03	5.1	303
1000	5	0.5	2.2E-03	5.0	302
1000	5	0.5	2.2E-03	5.1	303
		Average	2.2E-03	5.1	303
1000	10	0.5	2.0E-03	4.6	276
1000	10	0.5	2.0E-03	4.6	277
1000	10	0.5	2.0E-03	4.6	277
			2.0E-03	4.6	276
1000	24	0.5	1.8E-03	4.2	251
1000	24	0.5	1.8E-03	4.2	250
1000	24	0.5	1.8E-03	4.2	251
		Average	1.8E-03	4.2	251
1000	29	0.5	1.8E-03	4.0	242
1000	29	0.5	1.8E-03	4.1	244
1000	29	0.5	1.8E-03	4.1	244
		Average	1.8E-03	4.0	243
1000	48	0.5	1.7E-03	4.0	239
1000	48	0.5	1.7E-03	4.0	240
1000	48	0.5	1.8E-03	4.0	241
		Average	1.8E-03	4.0	240
1000	53	0.5	1.7E-03	4.0	238
1000	53	0.5	1.7E-03	4.0	239
1000	53	0.5	1.7E-03	4.0	238
		Average	1.7E-03	4.0	238
1000	72	0.5	1.7E-03	3.8	231
1000	72	0.5	1.7E-03	3.9	231
1000	72	0.5	1.7E-03	3.8	231
		Average	1.7E-03	3.8	231
1000	77	0.5	1.6E-03	3.7	225
1000	77	0.5	1.7E-03	3.8	227
1000	77	0.5	1.6E-03	3.8	225
		Average	1.6E-03	3.8	226
1000	100	0.5	1.6E-03	3.7	223
1000	100	0.5	1.6E-03	3.7	223
1000	100	0.5	1.6E-03	3.7	223
		Average	1.6E-03	3.7	223

Notes: (1) Flow rate calculated by measuring actual volume of flow during specific time interval.

Client:	Chenango Contracting, Inc.		
Project:	Iron Horse Park		
Project Location:	Billerica, MA		
GTX Project No.:	309168	Tested By:	dln
Test Date:	11/30/18	Checked By:	bfs
Sample ID:	Roll #131557033 (FT2-350E-08-08-E-00, FabriNet TRXH)		
Description:	Black, 350 mil GSE hi-flow double-sided nonwoven geocomposite		

Hydraulic Transmissivity - ASTM D4716

Specimen Length, in:	12
Specimen Width, in:	12
Boundary Conditions	(top to bottom): steel plate / soil / geocomposite / geomembrane / steel plate
Direction of Flow:	Machine Direction
Effluent Water Temperature, °C:	17.7

Normal Compressive Stress, psf	Seating Time, hours	Hydraulic Gradient	Transmissivity, m^2/sec	Unit Flow (See Note 1)	
				gal/min/ft	gal/hr/ft
1000	5	0.35	2.7E-03	4.4	263
1000	5	0.35	2.7E-03	4.4	263
1000	5	0.35	2.7E-03	4.4	263
		Average	2.7E-03	4.4	263
1000	10	0.35	2.4E-03	3.8	230
1000	10	0.35	2.3E-03	3.8	226
1000	10	0.35	2.3E-03	3.8	228
			2.3E-03	3.8	228
1000	24	0.35	2.1E-03	3.4	202
1000	24	0.35	2.1E-03	3.3	200
1000	24	0.35	2.1E-03	3.4	202
		Average	2.1E-03	3.4	201
1000	29	0.35	2.1E-03	3.3	199
1000	29	0.35	2.1E-03	3.3	197
1000	29	0.35	2.1E-03	3.3	198
		Average	2.1E-03	3.3	198
1000	48	0.35	2.0E-03	3.2	193
1000	48	0.35	2.0E-03	3.2	192
1000	48	0.35	2.0E-03	3.2	192
		Average	2.0E-03	3.2	193
1000	53	0.35	2.0E-03	3.2	190
1000	53	0.35	2.0E-03	3.2	191
1000	53	0.35	2.0E-03	3.1	188
		Average	2.0E-03	3.2	190
1000	72	0.35	2.0E-03	3.1	188
1000	72	0.35	2.0E-03	3.1	189
1000	72	0.35	2.0E-03	3.1	189
		Average	2.0E-03	3.1	188
1000	77	0.35	2.0E-03	3.1	187
1000	77	0.35	2.0E-03	3.1	188
1000	77	0.35	2.0E-03	3.1	187
		Average	2.0E-03	3.1	187
1000	100	0.35	1.9E-03	3.1	186
1000	100	0.35	1.9E-03	3.1	186
1000	100	0.35	1.9E-03	3.1	186
		Average	1.9E-03	3.1	186

Notes: (1) Flow rate calculated by measuring actual volume of flow during specific time interval.

Appendix G
Geocomposite Drainage Layer QA/QC Testing Results

Geocomposite Drainage Layer Product Information

CHENANGO CONTRACTING, INC

29 Arbutus Rd.
Johnson City, NY 13790
T: (607) 729-8500
F: (607) 729-2415
www.chenangocontracting.com

September 6, 2018

Mr. Chris Ryan
Charter Contracting Company
500 Harrison Ave Suite 4R
Boston, MA 02118

Subject: Iron Horse Park AOC 3
Geocomposite Submittal

Dear Mr. Ryan:

Please find attached submittal information for the proposed Geocomposite, GSE TrxNet 340mil w/8oz. Please see the attached GSE Manufacturing QA Manual, Installation QA Manual, and Material Properties Sheet.

If you have any questions concerning this submittal please do not hesitate to contact me.

Sincerely,
CHENANGO CONTRACTING, INC.

Nicholas S. Brechko

Attachments Physical Properties Sheet
GSE Submittal Literature

PRODUCT DATA SHEET

GSE TrxNet 340 mil Geocomposite

GSE TrxNet geocomposite consists of a 340 mil thick GSE TrxNet geonet heat-laminated on one or both sides with a GSE nonwoven needle-punched geotextile. The geotextile is available in mass per unit area range of 6 oz/yd² to 16 oz/yd². The geocomposite is designed and formulated to perform drainage function under a range of anticipated site loads, gradients and boundary conditions.

AT THE CORE:

A 340 mil thick TrxNet geonet heat-laminated on one or both sides with a nonwoven needlepunched geotextile.

Product Specifications

Tested Property	Test Method	Frequency	Minimum Average Roll Value[1]		
Geocomposite			6 oz/yd²	8 oz/yd²	10 oz/yd²
Transmissivity[2], gal/min/ft, (m²/sec) Double-Sided Composite Single-Sided Composite	ASTM D 4716	1/540,000 ft²	19.3 (4x10⁻³) 24.1 (5x10⁻³)	19.3 (4x10⁻³) 24.1 (5x10⁻³)	17.4 (3.5x10⁻³) 21.7 (4.5x10⁻³)
Ply Adhesion, lb/in	ASTM D 7005	1/50,000 ft²	0.5	0.5	0.5
Geonet Core[3] – GSE TrxNet					
Geonet Core Thickness, mil	ASTM D 5199	1/50,000 ft²	340	340	340
Transmissivity[2], gal/min/ft (m²/sec)	ASTM D 4716		48.3 (1 x 10⁻²)	48.3 (1 x 10⁻²)	48.3 (1 x 10⁻²)
Density, g/cm³	ASTM D 1505	1/50,000 ft²	0.94	0.94	0.94
Tensile Strength (MD), lb/in	ASTM D 7179	1/50,000 ft²	80	80	80
Carbon Black Content, %	ASTM D 4218	1/50,000 ft²	2.0	2.0	2.0
Geotextile[3]					
Mass per Unit Area, oz/yd²	ASTM D 5261	1/90,000 ft²	6	8	10
Grab Tensile Strength, lb	ASTM D 4632	1/90,000 ft²	160	220	260
Grab Elongation	ASTM D 4632	1/90,000 ft²	50%	50%	50%
CBR Puncture Strength, lb	ASTM D 6241	1/540,000 ft²	435	575	725
Trapezoidal Tear Strength, lb	ASTM D 4533	1/90,000 ft²	65	90	100
AOS, US sieve[1], (mm)	ASTM D 4751	1/540,000 ft²	70 (0.212)	80 (0.180)	100 (0.150)
Permittivity, sec⁻¹	ASTM D 4491	1/540,000 ft²	1.5	1.3	1.0
Water Flow Rate, gpm/ft²	ASTM D 4491	1/540,000 ft²	110	95	75
UV Resistance, % retained	ASTM D 4355 (after 500 hours)	per formulation	70	70	70
NOMINAL ROLL DIMENSIONS[4]					
Roll Width, ft			15	15	15
Roll Length, ft	Double-Sided Composite Single-Sided Composite		160 170	150 170	140 160
Roll Area, ft²	Double-Sided Composite Single-Sided Composite		2400 2550	2250 2550	2100 2400

NOTES:

- [1]All geotextile properties are minimum average roll values except AOS which is maximum average roll value and UV resistance is typical value. Geonet core thickness is nominal value.
- [2]Gradient of 0.1, normal load of 10,000 psf, water at 70˚F between steel plates for 15 minutes. Contact GSE for performance transmissivity value for use in design.
- [3]Component properties prior to lamination.
- [4]Roll widths and lengths have a tolerance of ±1%.

GSE is a leading manufacturer and marketer of geosynthetic lining products and services. We've built a reputation of reliability through our dedication to providing consistency of product, price and protection to our global customers.

Our commitment to innovation, our focus on quality and our industry expertise allow us the flexibility to collaborate with our clients to develop a custom, purpose-fit solution.

GSE ENVIRONMENTAL™

DURABILITY RUNS DEEP

For more information on this product and others, please visit us at GSEworld.com, call 800.435.2008 or contact your local sales office.

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GEONET & GEOCOMPOSITE PRODUCTS

MANUFACTURING QUALITY ASSURANCE MANUAL

Contents

1.0 INTRODUCTION

This manual provides an overview of the GSE Manufacturing Quality Assurance Program for GSE geonet and geocomposite products. It is intended for use by GSE's customers to enhance their understanding of the quality system under which GSE geonet and geocomposite products are manufactured.

2.0 COMMITMENT TO QUALITY

GSE is committed to meeting or exceeding customer's requirements and industry standards. This commitment to quality is established through a documented quality management system, continuous employee training, investment in technology and emphasis on process control. GSE has allocated resources to ensure that this commitment to quality translates into the best products and services for its customers.

3.0 MANUFACTURING QUALITY ASSURANCE

GSE has an on-site quality assurance laboratory at each manufacturing facility worldwide. Each facility has a fully equipped, well staffed, dedicated laboratory with strict guidelines to maintain a high level of quality and up-to-the-minute results on GSE's finished products.

GSE has a rigorous set of minimum standards and an effective test program to assure compliance has been established. These procedures and requirements are frequently reviewed and adjusted to assure compliance with current market demands and/or predetermined project specifications. Also raw materials and process parameters are controlled to provide products complying with GSE's minimum characteristics and regulatory standards.

4.0 MANUFACTURING QUALITY ASSURANCE ORGANIZATION

GSE quality assurance department assures that only products meeting GSE and/or the customer's requirements are released for shipment. The quality assurance personnel are directly responsible for monitoring, testing, and providing feedback to the manufacturing department ensuring the production of the specified product quality. Each member of the quality assurance team must participate in detailed training that includes factory exposure.

The GSE quality assurance team consists of the manufacturing quality assurance laboratories, engineering staff and manufacturing personnel. The combination of expertise and experience from these groups provide GSE with the proper tools to maintain the highest level of product quality and customer service in the industry.

5.0 STAFF & SCHEDULING

The quality assurance laboratories are staffed during any manufacturing run. A continuous communication link is maintained between the laboratory and manufacturing personnel, maximizing production efficiency and product quality.

6.0 PRODUCT IDENTIFICATION & DOCUMENTATION

A. Roll Numbering

Each roll of geonet and geocomposite is assigned a unique roll number. The quality assurance laboratory maintains records documenting the raw materials and resulting product quality information.

B. Approval Procedure

Results for each tested roll of product are checked against both GSE and customer's specifications for compliance. The quality assurance laboratory approves those materials that meet these requirements for shipment.

C. Non-Conformance

Material that does not meet GSE's minimum standards or customer's specifications is given a roll number, but is rejected and separated from the approved material. The rejected material is then identified as non-conformaning and will not be used. Material that meets GSE's minimum standards, but does not meet a stricter customer's specification will not be allocated to that customer, but will be placed into inventory as a GSE's standard material.

D. Documentation

Quality assurance certificates are generated and supplied for each roll of geonet and geocomposite product to include all relevant quality assurance information about the material. The geotextile components of the drainage geocomposite materials are tracked throughout the manufacturing process. Therefore, traceability reports are available.

7.0 RECORDS RETENTION

GSE maintains reports and/or samples for products produced and sold. Records and/or samples are maintained according to GSE's standard retention policy as outlined below.

MATERIAL	ITEM	YEAR
Raw Materials	Resin Supplier Test Reports and Certifications GSE Resin Test Reports Resin Sample Retain (Archive)	≥ 2 ≥ 2 ≥ 2
Geonets and Geocomposites	Raw Test Data (in computer database) Qualty Control Certificates (in computer database) Sample Retain (approximately one square foot)	≥ 5 ≥ 5 ≥ 5

8.0 TESTING CAPABILITIES

GSE maintains high capacity, state-of-the-art laboratory equipment suitable for performing the procedures in Houston, Texas, and Kingstree, South Carolina. Both quality assurance laboratories are accredited by the GAI-LAP Program. The appropriate certificates are maintained for review upon request by authorized parties.

A. Routine Testing

GSE has developed a strict quality assurance program, which exceeds all industry's standard practices and/or customer's specifications. The testing program covers raw materials and finished goods and is adhered to by all GSE's quality assurance laboratories. The laboratory equipment used by GSE represents the most modern equipment available and it meets or exceeds the requirements of all the test standards used. Test frequencies and the number of test specimen per sample are established based on statistical analysis and complexity of procedures.

B. Other Testing Capabilities

In addition to routine testing, GSE's laboratories are equipped to perform a wide variety of other tests as required for unusual requests or product development. Further, although the GSE quality assurance laboratories are fully equipped and able to perform most routinely specified tests in the industry, there are some tests that are more economically performed by a dedicated testing facility. GSE believes requirements for such testing should be carefully considered and defined in terms of specific design requirements if they are found to be necessary.

9.0 MATERIAL QUALITY ASSURANCE

GSE has established strict specifications for all raw materials and finished products. Test results must fall within the acceptable limits of GSE and customer's specifications.

A. Raw Material

GSE uses two types of raw materials in the manufacture of geonet products: natural resin and masterbatch. Natural resin is the base material that is used to make a geonet. It contains stabilizers to prevent degradation from occurring during and after extrusion. Masterbatch is the term referring to the concentrated carbon black material blended with the natural resin to produce the finished product. The natural resin and masterbatch are blended at the appropriate ratio at the manufacturing stage. The masterbatch can contain other additives depending upon the geonet product to be produced. GSE verifies the properties of each lot of raw material prior to their utilization. When natural resin is received, samples are taken and subjected to the tests as outlined in Appendix A. All

test data are entered into the computer database and checked for accuracy, consistency and compliance with GSE's specifications. The material is not accepted unless all standard test requirements are met and the GSE's test values meet the requirements set forth in the raw material specifications.

The GSE test results for each lot of resin are provided in a separate report upon request. Virgin resin is normally received in railcar lots. If resin is received by other transport and/or in other quantities, an equivalent suitable sampling procedure is provided (i.e. not less than one sample per shipment or one sample for each 50,000 lb, 23,000 kg).

In the production of geocomposite products, geotextiles laminated to one or both sides of the geonet can also be considered a raw material or component of the finished product. Quality assurance certificates are provided for all geotextile rolls bonded to the geocomposite.

B. Geonet Products

Geonet drainage products are produced with biplanar geometry. Please see GSE geonet data sheets for test methods, frequencies and specifications.

1. Sampling

   A one foot by roll width sample is cut for quality assurance testing from every tenth roll produced. An archive sample is cut from each tested roll. This sample is taken from a random location then labeled and stored for future reference. Test frequencies and the number of test specimen per sample are established based on statistical analysis of the available data and complexity of the test procedures.

2. Evaluation of Results

   All data are entered into a computer database for calculation and comparison to established order specifications. If materials do not meet the required GSE's standards and/or the customer's specifications, the manufacturing personnel will appropriately make the adjustments. Only products meeting GSE's standards and/or customer's specifications will be approved for shipment.

3. Reporting

   A quality assurance certificate is issued for every roll of finished product. This report identifies the standards on which the GSE approval is based along with the actual test results demonstrated by the material.

C. Geocomposite Products

Geocomposite products are produced by heat bonding a geotextile to one or both sides of a geonet product. Sampling evaluation of results and reporting practices are the same as for geonet products with the exception of testing for composite products. Please see GSE geocomposite data sheets for test methods, frequencies and specifications.

D. Third Party Conformance Sampling

Some specifications require independent quality assurance and/or conformance testing. GSE can provide assistance with the sampling of products by arranging for the conformance samples to be taken during production. By taking samples during production rather than on site or after production, the customer can be assured that the samples are clean and available for conformance testing in a timely manner.
GSE encourages customers to audit its manufacturing operations, to collect samples and conduct independent conformance testing prior to shipment of materials.

E. Product Shipping

It is GSE's policy to ship only products that have been tested and approved. All shipments are packaged according to industry's standard practices and/or customer's specifications. Only approved handling methods are used to move rolls into and out of shipping containers, please see the GSE Installation Quality Assurance Manual for more details.

Appendix A: Minimum Testing Frequencies for GSE Raw Materials

Property	Test Metod[1]	Natural Resin
Density	ASTM D 1505	once per resin lot
Melt Flow Index	ASTM D 1238 (190/2.16)	once per resin lot
Carbon Black Content	ASTM D 1603*/4218	N/A
Carbon Black Dispersion	ASTM D 5596	N/A

Notes:

- GSE utilizes test equipment and procedures that enable effective and economical confirmation that the product will conform to specifications based on the noted procedures. Some test procedures have been modified for application to geosynthetics. All procedures and values are subject to change without prior notification.
- Refer to GSE's ISO 9000 quality manual for raw material requirements for individual products.
- *Modified.

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Our commitment to innovation, our focus on quality and our industry expertise allow us the flexibility to collaborate with our clients to develop a custom, purpose-fit solution.

For more information on this product and others, please visit us at GSEworld.com, call 800.435.2008 or contact your local sales office.

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GEONET & GEOCOMPOSITE PRODUCTS
INSTALLATION QUALITY ASSURANCE MANUAL

Contents

1.0 INTRODUCTION

This manual provides an overview of the GSE Installation Quality Assurance procedures consistent with industry accepted practices to ensure that the geonet and geocomposite products installed will best perform for its intended purpose. In addition, all installation work will be performed in strict accordance per the customer's specifications. Please read the procedures below completely before you begin. If you need further clarification, contact the GSE Engineering Support Staff for assistance. Remember safety first and use safe practices always on every project.

2.0 ROLL PACKAGING

GSE geocomposite rolls shall be shipped from the factory in an opaque protective covering to prevent damage and UV degradation. However, GSE geonets do not need to be further protected from UV degradation during shipping or storage.

3.0 MATERIAL DELIVERY

A. Upon arrival on site, QA personnel will inventory all materials on-site.

B. Roll numbers of the geonet or geocomposite will be logged on the Inventory Check List (Appendix A) and cross-referenced with the Bill of Lading.

C. Copies of the Inventory Check List and signed Bill of Lading should be sent to GSE corporate headquarters while the on-site QA personnel retains the original copies.

D. Any visible damage to roll materials should be noted on the roll and Inventory Check List.

4.0 UNLOADING & STORAGE PROCEDURES

A. Rolls of material shall be unloaded with equipment that will not damage the geonet or geocomposite.

B. Fabric-straps, spreader bars, stinger bars, or other approved equipment shall be used for handling rolls of geonet and geocomposite.

C. Materials should be stored in a flat, dry and well drained area.

D. The surface shall be free of sharp rocks or other objects that could damage the materials.

5.0 SUBGRADE PREPARATION

The subgrade shall be free of sharp rocks or other objects that could otherwise cause damage to the materials.

6.0 DEPLOYMENT

Geonet and geocomposite shall be handled in a careful manner to ensure that it is not damaged in anyway.

A. On slopes, the material shall be anchored in the anchor trench and then rolled down the slope in such a manner as to continually keep the material under tension.

B. In the presence of wind, the leading edge of the material shall be weighted with temporary ballasting, such as sandbags until the final cover is placed.

C. Care shall be taken to assure that any underlying layers are not damaged during placement. Low ground pressure machines, such as ATV's to facilitate deployment over the geosynthetic layers is allowed. Low ground pressure machines are machines with a ground pressure less than 8 psi when carrying a driver weighing approximately 150 lbs.

D. Care shall be taken to avoid entrapment of stones, mud and other materials during placement operations.

7.0 OVERLAPS & SEAMS

A. The recommended geonet overlap in the machine direction is 3.0 in to 5.0 in. The recommended overlap in the transverse direction is 6.0 in to 12.0 in.

B. On slopes the ends of the materials shall be shingled down in the direction of the slope.

C. A plastic cable tie should be placed once per every five linear feet in the machine direction and once per every linear foot in the transverse direction.

D. f the product is a geocomposite, the geotextile on the bottom shall be overlapped and the geotextile on top shall be overlapped, sewn or heat bonded. The exact seaming method or overlap is typically specified in project construction documents.

8.0 COVER SOIL PLACEMENT

A. Prior to placement of cover soil, a Certificate of Acceptance (Appendix B) must be signed by a responsible party and an installer's representative.

B. Any cover material, such as soil, that is placed over the drainage material shall be placed with care to assure the material is not damaged.

C. Care shall be taken to minimize any movement of the geonet or geocomposite and to assure that no tensile stress is induced in the material.

D. Cover soils deployed over the geonet or geocomposite should be free of all sharp objects, sharp rocks and sticks.

E. Wide track equipment should be used to distribute cover soil over the geocomposite.

F. A minimum of 12.0 in of cover soil is required to separate the equipment from the geocomposite to prevent damage.

Geocomposite Drainage Layer Manufacturers Quality Control Testing

GSE Environmental, LLC

ROLL TEST DATA REPORT

GSE QC APPROVED

Report Date: Nov/13/2018

Sales Order No.	Customer Name	Project Location	Product Name	BOL Number
SO-085609	Chenango Contracting	North Billerica MA US	FT2-350E-08-08-E-00	

Roll Number	Geonet Thickness ASTM D5199 (mils)	Tensile Strength ASTM D7179 (ppi)	Density ASTM D1505 (g/cc)	Carbon Black Content ASTM D4218 (%)	Ply Adhesion Average ASTM D7005 (ppi) Side A	Ply Adhesion Average ASTM D7005 (ppi) Side B
131557033	348	134	0.954	2.5	2.0	1.8
131557034	348	121	0.956	2.4	1.6	1.7
131557035	348	121	0.956	2.4	1.6	1.7
131557036	348	121	0.956	2.4	1.6	1.7
131557037	348	121	0.956	2.4	1.6	1.7
131557038	348	121	0.956	2.4	1.6	1.7
131557039	348	121	0.956	2.4	1.6	1.7
131557040	348	121	0.956	2.4	1.6	1.7
131557041	348	121	0.956	2.4	1.6	1.7
131557042	348	121	0.956	2.4	1.6	1.7
131557043	348	121	0.956	2.4	1.6	1.7
131557044	348	121	0.956	2.4	1.6	1.7
131557045	348	121	0.956	2.4	1.6	1.7
131557046	348	121	0.956	2.4	1.6	1.7
131557047	348	121	0.956	2.4	1.6	1.7
131557048	348	121	0.956	2.4	1.6	1.7
131557049	348	121	0.956	2.4	1.6	1.7
131557050	348	121	0.956	2.4	1.6	1.7
131557051	348	121	0.956	2.4	1.6	1.7
131557052	348	121	0.956	2.4	1.6	1.7
131557053	348	121	0.956	2.4	1.6	1.7
131557054	348	121	0.956	2.4	1.6	1.7
131557055	348	121	0.956	2.4	1.6	1.7
131557056	346	129	0.961	2.5	1.9	3.0
131557057	346	129	0.961	2.5	1.9	3.0
131557058	346	129	0.961	2.5	1.9	3.0
131557059	346	129	0.961	2.5	1.9	3.0
131557060	346	129	0.961	2.5	1.9	3.0
131557061	346	129	0.961	2.5	1.9	3.0
131557062	346	129	0.961	2.5	1.9	3.0
131557063	346	129	0.961	2.5	1.9	3.0
131557064	346	129	0.961	2.5	1.9	3.0
131557065	346	129	0.961	2.5	1.9	3.0
131557066	346	129	0.961	2.5	1.9	3.0

GSE Environmental, LLC

ROLL TEST DATA REPORT

GSE QC APPROVED

Report Date: Nov/13/2018

Sales Order No.	Customer Name	Project Location	Product Name	BOL Number
SO-085609	Chenango Contracting	North Billerica MA US	FT2-350E-08-08-E-00	

Roll Number	Geonet Thickness ASTM D5199 (mils)	Tensile Strength ASTM D7179 (ppi)	Density ASTM D1505 (g/cc)	Carbon Black Content ASTM D4218 (%)	Ply Adhesion Average ASTM D7005 (ppi) Side A	Ply Adhesion Average ASTM D7005 (ppi) Side B
131557067	346	129	0.961	2.5	1.9	3.0
131557068	346	129	0.961	2.5	1.9	3.0
131557069	346	129	0.961	2.5	1.9	3.0
131557070	346	129	0.961	2.5	1.9	3.0
131557071	346	129	0.961	2.5	1.9	3.0
131557072	346	129	0.961	2.5	1.9	3.0
131557073	346	129	0.961	2.5	1.9	3.0
131557074	346	129	0.961	2.5	1.9	3.0
131557075	346	129	0.961	2.5	1.9	3.0
131557076	346	129	0.961	2.5	1.9	3.0
131557077	346	129	0.961	2.5	1.9	3.0
131557078	342	125	0.958	2.5	1.8	3.3
131557079	342	125	0.958	2.5	1.8	3.3
131557080	342	125	0.958	2.5	1.8	3.3
131557081	342	125	0.958	2.5	1.8	3.3
131557082	342	125	0.958	2.5	1.8	3.3
131557083	342	125	0.958	2.5	1.8	3.3
131557084	342	125	0.958	2.5	1.8	3.3
131557085	342	125	0.958	2.5	1.8	3.3
131557086	342	125	0.958	2.5	1.8	3.3
131557087	342	125	0.958	2.5	1.8	3.3
131557089	342	125	0.958	2.5	1.8	3.3
131557090	342	125	0.958	2.5	1.8	3.3
131557091	342	125	0.958	2.5	1.8	3.3
131557092	342	125	0.958	2.5	1.8	3.3
131557093	342	125	0.958	2.5	1.8	3.3
131557094	342	125	0.958	2.5	1.8	3.3
131557095	342	125	0.958	2.5	1.8	3.3
131557096	342	125	0.958	2.5	1.8	3.3
131557097	342	125	0.958	2.5	1.8	3.3
131557098	342	125	0.958	2.5	1.8	3.3
131557099	342	125	0.958	2.5	1.8	3.3
131557100	342	131	0.960	2.6	2.6	4.1
131557101	342	131	0.960	2.6	2.6	4.1

GSE Environmental, LLC

ROLL TEST DATA REPORT

Report Date: Nov/13/2018

Sales Order No.	Customer Name	Project Location	Product Name	BOL Number
SO-085609	Chenango Contracting	North Billerica MA US	FT2-350E-08-08-E-00	

Roll Number	Geonet Thickness ASTM D5199 (mils)	Tensile Strength ASTM D7179 (ppi)	Density ASTM D1505 (g/cc)	Carbon Black Content ASTM D4218 (%)	Ply Adhesion Average ASTM D7005 (ppi) Side A	Ply Adhesion Average ASTM D7005 (ppi) Side B
131557102	342	131	0.960	2.6	2.6	4.1
131557103	342	131	0.960	2.6	2.6	4.1
131557104	342	131	0.960	2.6	2.6	4.1
131557105	342	131	0.960	2.6	2.6	4.1
131557106	342	131	0.960	2.6	2.6	4.1
131557107	342	131	0.960	2.6	2.6	4.1
131557108	342	131	0.960	2.6	2.6	4.1
131557109	342	131	0.960	2.6	2.6	4.1
131557110	342	131	0.960	2.6	2.6	4.1
131557111	342	131	0.960	2.6	2.6	4.1
131557112	342	131	0.960	2.6	2.6	4.1

Laboratory Manager

GSE Lining Technology, LLC.

ROLL TEST DATA REPORT

Report Date: Nov/13/2018

Sales Order No.	Customer Name	Project Location	Product Name	BOL Number
SO-085609	Chenango Contracting	North Billerica MA US	FBR-080E-EBC-E-005	

GSE QC APPROVED

ROLL #	ASTM D4751 A0S (mm)	ASTM D6241 CBR PUNCTURE (lbs)	Mass per Unit Area ASTM D5261 (oz/yd²)	ASTM D4632 Elongation @ Break (%) MD	ASTM D4632 Grab Strength (lbs) MD	ASTM D4533 Trapezoidoal Tear (lbs) MD	ASTM D4491 Permittivity (sec-1)	ASTM D4833 Puncture Resistance (lbs)	Water Flow D4491 gpm/ft2	ASTM D4632 Elongation @ Break (%) TD	ASTM D4632 Grab Strength (lbs) TD	ASTM D4533 Trapezoidoal Tear (lbs) TD
2025751665	0.180	714	9.4	83	307	100	1.8	165	100	90	387	137
2025751668	0.180	757	9.1	81	288	104	1.8	156	132	89	350	121
2025751717	0.180	784	8.4	82	296	105	2.0	157	147	90	337	118
2025751719	0.180	799	8.2	76	290	98	1.5	143	112	86	325	113
2025751721	0.180	799	8.2	76	290	98	1.5	143	112	86	325	113
2025751722	0.180	856	9.3	78	294	106	1.5	159	114	83	332	138
2025751723	0.180	856	9.3	78	294	106	1.5	159	114	83	332	138
2025751724	0.180	856	9.3	78	294	106	1.5	159	114	83	332	138
2025751725	0.180	856	9.3	78	294	106	1.5	159	114	83	332	138
2025751726	0.180	811	9.3	87	298	104	1.6	163	116	95	356	120
2025751729	0.180	811	9.3	87	298	104	1.6	163	116	95	356	120
2025751731	0.180	850	8.9	80	292	115	2.1	158	153	95	380	132
2025751733	0.180	850	8.9	80	292	115	2.1	158	153	95	380	132
2025751738	0.180	802	9.1	83	292	107	2.1	161	153	95	368	136
2025751750	0.180	848	9.4	78	302	108	2.0	189	144	88	362	127
2025757514	0.180	788	8.4	77	250	96	1.8	141	130	95	311	110
2025757517	0.180	950	9.6	81	309	128	1.8	177	130	87	339	150
2025757522	0.180	808	8.6	79	291	118	1.8	168	132	88	332	136
2025757527	0.180	870	9.3	77	292	114	1.8	164	133	90	353	138

Laboratory Manager: Thomas E. Harrelson

Formosa Plastics

FORMOSA PLASTICS CORPORATION, TEXAS
201 FORMOSA DRIVE
PO BOX 700
POINT COMFORT TX 77978
PHONE:(888)FPCUSA3

Certificate of Analysis

(CONFIDENTIAL)

CUSTOMER:GSE ENVIRONMENTAL LLC
1245 EASTLAND AVE
KINGSTREE SC 29556
PRODUCT :HB5502B
RAILCAR FPAX201220
CLEANING/INSPECTION NO: 201220082718

S/O NO : ET9A241
CUSTOMER PO : 03-513784
DATE SHIPPED: 9/18/18
LOT NO : 18H1331
WEIGHT (LB) : 198,350.00
CUSTID:FT03112 SPIDE3

TEST ITEM	REFERENCE METHOD	TEST VALUE
Melt Index,g/10min	ASTM D1238	.33
Density, g/cm3	ASTM D1505	.9540

Linda Kao

QC SUPERVISOR: LINDA KAO

GSE ENVIRONMENTAL™ GSE Environmental, LLC.

Transmissivity Report

ASTM D4716

Roll No. 131557033

ROLL IDENTIFICATION

Roll Number	131557033
Product Name	FT2-350E-08-08-E-00
Production Date	11/7/2018

CUSTOMER INFORMATION

Order Number	85609
Customer Name	Chenango Contracting
Project Name	Chenango/Iron Horse LF
Location	North Billerica MA US

Pressure (psf)	*Gradient*	*Net/Composite*	*Transmissivity Results* (m^2/sec)	(gal/min/ft)	*Seat Time (min)*	*Boundary*
1,000	0.10	Composite	5.77E-03	27.87	6000	soil/geocomposite/geomembrane
1,000	0.20	Composite	4.25E-03	20.53	6000	soil/geocomposite/geomembrane
1,000	0.35	Composite	3.39E-03	16.38	6000	soil/geocomposite/geomembrane
1,000	0.50	Composite	2.90E-03	14.01	6000	soil/geocomposite/geomembrane

GSE QC APPROVED

GSE Roll Allocation

Order SO-085609

Customer Chenango Contracting

Project Name Iron Horse LF

GeoTesting
Express
3ft x roll width, 2 samples from the same roll

Roll#	Resin Lot	Product Code	Mfg Date	Length	Sent
131557033	18H1331	FT2-350E-08-08-E-00	11/7/2018	150	9-Nov
131557034	18H1331	FT2-350E-08-08-E-00	11/7/2018	150	
131557035	18H1331	FT2-350E-08-08-E-00	11/7/2018	150	
131557036	18H1331	FT2-350E-08-08-E-00	11/7/2018	150	
131557037	18H1331	FT2-350E-08-08-E-00	11/7/2018	150	
131557038	18H1331	FT2-350E-08-08-E-00	11/7/2018	150	
131557039	18H1331	FT2-350E-08-08-E-00	11/7/2018	150	
131557040	18H1331	FT2-350E-08-08-E-00	11/7/2018	150	
131557041	18H1331	FT2-350E-08-08-E-00	11/7/2018	150	
131557042	18H1331	FT2-350E-08-08-E-00	11/7/2018	150	
131557043	18H1331	FT2-350E-08-08-E-00	11/7/2018	150	
131557044	18H1331	FT2-350E-08-08-E-00	11/7/2018	150	
131557045	18H1331	FT2-350E-08-08-E-00	11/7/2018	150	
131557046	18H1331	FT2-350E-08-08-E-00	11/7/2018	150	
131557047	18H1331	FT2-350E-08-08-E-00	11/7/2018	150	
131557048	18H1331	FT2-350E-08-08-E-00	11/7/2018	150	
131557049	18H1331	FT2-350E-08-08-E-00	11/7/2018	150	
131557050	18H1331	FT2-350E-08-08-E-00	11/7/2018	150	
131557051	18H1331	FT2-350E-08-08-E-00	11/7/2018	150	
131557052	18H1331	FT2-350E-08-08-E-00	11/7/2018	150	
131557053	18H1331	FT2-350E-08-08-E-00	11/7/2018	150	
131557054	18H1331	FT2-350E-08-08-E-00	11/7/2018	150	
131557055	18H1331	FT2-350E-08-08-E-00	11/7/2018	150	
131557056	18H1331	FT2-350E-08-08-E-00	11/7/2018	150	
131557057	18H1331	FT2-350E-08-08-E-00	11/8/2018	150	
131557058	18H1331	FT2-350E-08-08-E-00	11/8/2018	150	
131557059	18H1331	FT2-350E-08-08-E-00	11/8/2018	150	
131557060	18H1331	FT2-350E-08-08-E-00	11/8/2018	150	
131557061	18H1331	FT2-350E-08-08-E-00	11/8/2018	150	
131557062	18H1331	FT2-350E-08-08-E-00	11/8/2018	150	
131557063	18H1331	FT2-350E-08-08-E-00	11/8/2018	150	
131557064	18H1331	FT2-350E-08-08-E-00	11/8/2018	150	
131557065	18H1331	FT2-350E-08-08-E-00	11/8/2018	150	
131557066	18H1331	FT2-350E-08-08-E-00	11/8/2018	150	
131557067	18H1331	FT2-350E-08-08-E-00	11/8/2018	150	
131557068	18H1331	FT2-350E-08-08-E-00	11/8/2018	150	
131557069	18H1331	FT2-350E-08-08-E-00	11/8/2018	150	
131557070	18H1331	FT2-350E-08-08-E-00	11/8/2018	150	
131557071	18H1331	FT2-350E-08-08-E-00	11/8/2018	150	
131557072	18H1331	FT2-350E-08-08-E-00	11/8/2018	150	
131557073	18H1331	FT2-350E-08-08-E-00	11/8/2018	150	
131557074	18H1331	FT2-350E-08-08-E-00	11/8/2018	150	
131557075	18H1331	FT2-350E-08-08-E-00	11/8/2018	150	
131557076	18H1331	FT2-350E-08-08-E-00	11/8/2018	150	
131557077	18H1331	FT2-350E-08-08-E-00	11/8/2018	150	
131557078	18H1331	FT2-350E-08-08-E-00	11/8/2018	150	
131557079	18H1331	FT2-350E-08-08-E-00	11/8/2018	150	
131557080	18H1331	FT2-350E-08-08-E-00	11/8/2018	150	

131557081	18H1331	FT2-350E-08-08-E-00	11/8/2018	150
131557082	18H1331	FT2-350E-08-08-E-00	11/8/2018	150
131557083	18H1331	FT2-350E-08-08-E-00	11/8/2018	150
131557084	18H1331	FT2-350E-08-08-E-00	11/8/2018	150
131557085	18H1331	FT2-350E-08-08-E-00	11/8/2018	150
131557086	18H1331	FT2-350E-08-08-E-00	11/8/2018	150
131557087	18H1331	FT2-350E-08-08-E-00	11/8/2018	150
131557089	18H1331	FT2-350E-08-08-E-00	11/8/2018	150
131557090	18H1331	FT2-350E-08-08-E-00	11/8/2018	150
131557091	18H1331	FT2-350E-08-08-E-00	11/8/2018	150
131557092	18H1331	FT2-350E-08-08-E-00	11/8/2018	150
131557093	18H1331	FT2-350E-08-08-E-00	11/8/2018	150
131557094	18H1331	FT2-350E-08-08-E-00	11/8/2018	150
131557095	18H1331	FT2-350E-08-08-E-00	11/8/2018	150
131557096	18H1331	FT2-350E-08-08-E-00	11/8/2018	150
131557097	18H1331	FT2-350E-08-08-E-00	11/8/2018	150
131557098	18H1331	FT2-350E-08-08-E-00	11/8/2018	150
131557099	18H1331	FT2-350E-08-08-E-00	11/8/2018	150
131557100	18H1331	FT2-350E-08-08-E-00	11/8/2018	150
131557101	18H1331	FT2-350E-08-08-E-00	11/8/2018	150
131557102	18H1331	FT2-350E-08-08-E-00	11/8/2018	150
131557103	18H1331	FT2-350E-08-08-E-00	11/8/2018	150
131557104	18H1331	FT2-350E-08-08-E-00	11/8/2018	150
131557105	18H1331	FT2-350E-08-08-E-00	11/8/2018	150
131557106	18H1331	FT2-350E-08-08-E-00	11/8/2018	150
131557107	18H1331	FT2-350E-08-08-E-00	11/8/2018	150
131557108	18H1331	FT2-350E-08-08-E-00	11/8/2018	150
131557109	18H1331	FT2-350E-08-08-E-00	11/8/2018	150
131557110	18H1331	FT2-350E-08-08-E-00	11/8/2018	150
131557111	18H1331	FT2-350E-08-08-E-00	11/8/2018	150
131557112	18H1331	FT2-350E-08-08-E-00	11/8/2018	150

GSE ENVIRONMENTAL™

GSE Environmental, LLC.

Transmissivity Report

ASTM D4716

Test Conditions		*CUSTOMER INFORMATION*	
Pressure	***1,000 psf***	***Order Number***	85609
Seat Time	***6000 minutes***	***Customer Name***	Chenango Contracting
Boundary	***soil/geocomposite/geomembrane***	***Project Name***	Chenango/Iron Horse LF
		Location	North Billerica MA US

Roll#	Transmissivity (m^2/sec) @ Gradient 0.10	Transmissivity (m^2/sec) @ Gradient 0.20	Transmissivity (m^2/sec) @ Gradient 0.35	Transmissivity (m^2/sec @ Gradient 0.50
131557033	5.77E-03	4.25E-03	3.39E-03	2.90E-03
131557034	5.77E-03	4.25E-03	3.39E-03	2.90E-03
131557035	5.77E-03	4.25E-03	3.39E-03	2.90E-03
131557036	5.77E-03	4.25E-03	3.39E-03	2.90E-03
131557037	5.77E-03	4.25E-03	3.39E-03	2.90E-03
131557038	5.77E-03	4.25E-03	3.39E-03	2.90E-03
131557039	5.77E-03	4.25E-03	3.39E-03	2.90E-03
131557040	5.77E-03	4.25E-03	3.39E-03	2.90E-03
131557041	5.77E-03	4.25E-03	3.39E-03	2.90E-03
131557042	5.77E-03	4.25E-03	3.39E-03	2.90E-03
131557043	5.77E-03	4.25E-03	3.39E-03	2.90E-03
131557044	5.77E-03	4.25E-03	3.39E-03	2.90E-03
131557045	5.77E-03	4.25E-03	3.39E-03	2.90E-03
131557046	5.77E-03	4.25E-03	3.39E-03	2.90E-03
131557047	5.77E-03	4.25E-03	3.39E-03	2.90E-03
131557048	5.77E-03	4.25E-03	3.39E-03	2.90E-03
131557049	5.77E-03	4.25E-03	3.39E-03	2.90E-03
131557050	5.77E-03	4.25E-03	3.39E-03	2.90E-03
131557051	5.77E-03	4.25E-03	3.39E-03	2.90E-03
131557052	5.77E-03	4.25E-03	3.39E-03	2.90E-03
131557053	5.77E-03	4.25E-03	3.39E-03	2.90E-03
131557054	5.77E-03	4.25E-03	3.39E-03	2.90E-03
131557055	5.77E-03	4.25E-03	3.39E-03	2.90E-03
131557056	5.77E-03	4.25E-03	3.39E-03	2.90E-03
131557057	5.77E-03	4.25E-03	3.39E-03	2.90E-03
131557058	5.77E-03	4.25E-03	3.39E-03	2.90E-03
131557059	5.77E-03	4.25E-03	3.39E-03	2.90E-03
131557060	5.77E-03	4.25E-03	3.39E-03	2.90E-03
131557061	5.77E-03	4.25E-03	3.39E-03	2.90E-03
131557062	5.77E-03	4.25E-03	3.39E-03	2.90E-03
131557063	5.77E-03	4.25E-03	3.39E-03	2.90E-03

131557064	5.77E-03	4.25E-03	3.39E-03	2.90E-03
131557065	5.77E-03	4.25E-03	3.39E-03	2.90E-03
131557066	5.77E-03	4.25E-03	3.39E-03	2.90E-03
131557067	5.77E-03	4.25E-03	3.39E-03	2.90E-03
131557068	5.77E-03	4.25E-03	3.39E-03	2.90E-03
131557069	5.77E-03	4.25E-03	3.39E-03	2.90E-03
131557070	5.77E-03	4.25E-03	3.39E-03	2.90E-03
131557071	5.77E-03	4.25E-03	3.39E-03	2.90E-03
131557072	5.77E-03	4.25E-03	3.39E-03	2.90E-03
131557073	5.77E-03	4.25E-03	3.39E-03	2.90E-03
131557074	5.77E-03	4.25E-03	3.39E-03	2.90E-03
131557075	5.77E-03	4.25E-03	3.39E-03	2.90E-03
131557076	5.77E-03	4.25E-03	3.39E-03	2.90E-03
131557077	5.77E-03	4.25E-03	3.39E-03	2.90E-03
131557078	5.77E-03	4.25E-03	3.39E-03	2.90E-03
131557079	5.77E-03	4.25E-03	3.39E-03	2.90E-03
131557080	5.77E-03	4.25E-03	3.39E-03	2.90E-03
131557081	5.77E-03	4.25E-03	3.39E-03	2.90E-03
131557082	5.77E-03	4.25E-03	3.39E-03	2.90E-03
131557083	5.77E-03	4.25E-03	3.39E-03	2.90E-03
131557084	5.77E-03	4.25E-03	3.39E-03	2.90E-03
131557085	5.77E-03	4.25E-03	3.39E-03	2.90E-03
131557086	5.77E-03	4.25E-03	3.39E-03	2.90E-03
131557087	5.77E-03	4.25E-03	3.39E-03	2.90E-03
131557089	5.77E-03	4.25E-03	3.39E-03	2.90E-03
131557090	5.77E-03	4.25E-03	3.39E-03	2.90E-03
131557091	5.77E-03	4.25E-03	3.39E-03	2.90E-03
131557092	5.77E-03	4.25E-03	3.39E-03	2.90E-03
131557093	5.77E-03	4.25E-03	3.39E-03	2.90E-03
131557094	5.77E-03	4.25E-03	3.39E-03	2.90E-03
131557095	5.77E-03	4.25E-03	3.39E-03	2.90E-03
131557096	5.77E-03	4.25E-03	3.39E-03	2.90E-03
131557097	5.77E-03	4.25E-03	3.39E-03	2.90E-03
131557098	5.77E-03	4.25E-03	3.39E-03	2.90E-03
131557099	5.77E-03	4.25E-03	3.39E-03	2.90E-03
131557100	5.77E-03	4.25E-03	3.39E-03	2.90E-03
131557101	5.77E-03	4.25E-03	3.39E-03	2.90E-03
131557102	5.77E-03	4.25E-03	3.39E-03	2.90E-03
131557103	5.77E-03	4.25E-03	3.39E-03	2.90E-03
131557104	5.77E-03	4.25E-03	3.39E-03	2.90E-03
131557105	5.77E-03	4.25E-03	3.39E-03	2.90E-03
131557106	5.77E-03	4.25E-03	3.39E-03	2.90E-03
131557107	5.77E-03	4.25E-03	3.39E-03	2.90E-03
131557108	5.77E-03	4.25E-03	3.39E-03	2.90E-03
131557109	5.77E-03	4.25E-03	3.39E-03	2.90E-03
131557110	5.77E-03	4.25E-03	3.39E-03	2.90E-03
131557111	5.77E-03	4.25E-03	3.39E-03	2.90E-03
131557112	5.77E-03	4.25E-03	3.39E-03	2.90E-03

Appendix H
Piezometer Decommissioning Reports

Well Location GPS: N: 575709.31 E: 662809.24

1. Property Owner Information:

Name: Pan Am Railways
Address: 1700 Iron Horse Park North Billerica, MA 01862
In Public Right-of-Way (Y/N): N

2. Well Information:

Well Designation: PZ-104A
Date Decommissioned: 10/22/2018
Depth of Decommissioned Well: 14.5 ft
Well Type Prior to Decommission: Piezometer
Well Ended in Formation Type: Overburden
Was New Well Drilled (Y/N): N

3. Casing Information

Casing Type: PVC
Casing Diameter: 2"
Was Casing Left in Place (Y/N): Y
Was Casing Ripped or Perforated (Y/N): N
Were Obstructions left in the well (Y/N): N
If yes, what type? N/A
Surface Seal: Bentonite/Landfill

Description of Decommissioning Material:

Piezometer was abandoned in place through filling with bentonite and cutting PVC at the surface. The stick up was removed and the abandoned location was covered with a single-barrier landfill cap.

Decommissioned by: Charter Contracting Company, LLC.

ERM
One Beacon Street, 5th Floor, Boston MA, 02108

Well Location GPS: N: 575459.85 E: 662502.84

1. Property Owner Information:

Name: Pan Am Railways
Address: 1700 Iron Horse Park North Billerica, MA 01862
In Public Right-of-Way (Y/N): N

2. Well Information:

Well Designation: PZ-104B
Date Decommissioned: 10/22/2018
Depth of Decommissioned Well: 15.0 ft
Well Type Prior to Decommission: Piezometer
Well Ended in Formation Type: Overburden
Was New Well Drilled (Y/N): N

3. Casing Information

Casing Type: PVC
Casing Diameter: 2"
Was Casing Left in Place (Y/N): Y
Was Casing Ripped or Perforated (Y/N): N
Were Obstructions left in the well (Y/N): N
If yes, what type? N/A
Surface Seal: Bentonite/Landfill

Description of Decommissioning Material:

Piezometer was abandoned in place through filling with bentonite and cutting PVC at the surface. The stick up was removed and the abandoned location was covered with a single-barrier landfill cap.

Decommissioned by: Charter Contracting Company, LLC.

ERM
One Beacon Street, 5th Floor, Boston MA, 02108

Well Location GPS: N: 575618.99 E: 662772.47

1. Property Owner Information:

Name: Pan Am Railways
Address: 1700 Iron Horse Park North Billerica, MA 01862
In Public Right-of-Way (Y/N): N

2. Well Information:

Well Designation: PZ-105B
Date Decommissioned: 10/22/2018
Depth of Decommissioned Well: 14.0 ft
Well Type Prior to Decommission: Piezometer
Well Ended in Formation Type: Overburden
Was New Well Drilled (Y/N): N

3. Casing Information

Casing Type: PVC
Casing Diameter: 2"
Was Casing Left in Place (Y/N): Y
Was Casing Ripped or Perforated (Y/N): N
Were Obstructions left in the well (Y/N): N
If yes, what type? N/A
Surface Seal: Bentonite/Landfill

Description of Decommissioning Material:

Piezometer was abandoned in place through filling with bentonite and cutting PVC at the surface. The stick up was removed and the abandoned location was covered with a single-barrier landfill cap.

Decommissioned by: Charter Contracting Company, LLC.

ERM
One Beacon Street, 5th Floor, Boston MA, 02108

Well Location GPS: N: 575451.00 E: 662803.44

1. Property Owner Information:

Name: Pan Am Railways
Address: 1700 Iron Horse Park North Billerica, MA 01862
In Public Right-of-Way (Y/N): N

2. Well Information:

Well Designation: PZ-106B
Date Decommissioned: 10/22/2018
Depth of Decommissioned Well: 15.0 ft
Well Type Prior to Decommission: Piezometer
Well Ended in Formation Type: Overburden
Was New Well Drilled (Y/N): N

3. Casing Information

Casing Type: PVC
Casing Diameter: 2"
Was Casing Left in Place (Y/N): Y
Was Casing Ripped or Perforated (Y/N): N
Were Obstructions left in the well (Y/N): N
If yes, what type? N/A
Surface Seal: Bentonite/Landfill

Description of Decommissioning Material:

Piezometer was abandoned in place through filling with bentonite and cutting PVC at the surface. The stick up was removed and the abandoned location was covered with a single-barrier landfill cap.

Decommissioned by: Charter Contracting Company, LLC.

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